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Forest Service

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Report
WO-21

Timber in the United States Ec
1963, 1967, and

Timber in the United States Ec
1963, 1967, and 1972

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Forest Service

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Preface

This report presents estimates of employment and value added in timber-based activities in the United States in 1972, 1967, 1963. Also included are data on the volume of stumpage cut, the value of logs and related products harvested, the volumes of selected timber products produced, the value of shipments from timber-based primary and secondary manufacturing industries, the value of construction, freight revenues from shipments of timber products, and wholesale and retail sales of timber products.

In basic concept, organization, and most computational procedures, this study parallels an earlier one, *The Economic Importance of Timber in the United States,* published in 1963. In most respects, the data presented are comparable with those from the 1963 study. However, in some instances, lack of new information, revisions in industry definitions, or other modifications in basic data sources have necessitated slight changes in organization or compilation procedures. Such changes, however, do not significantly affect comparability between the two studies.

The information in *Timber in the United States Economy, 1963, 1967, and 1972* is a historical record of timber's contribution to the Nation's economy. When used in conjunction with *The E*
Timber in the United States, 19
complete analysis covering two
points at approximately 5-year i

The estimates in this report a
1960 and 1970 *Censuses of Pop*
and 1972 *Censuses of Business;* a
and surveys conducted by the F
ernment agencies, and individua
on sources and procedures used
piling the information presented
the footnotes to the tables and i

Many people have provided a
and preparation of this report.
is given to Dwight Hair, Leade
and Trade Analysis Group, For
Research Staff. Keith Blatner,
Dubose, Isabel Fisk, Timothy F
John Maine, and Douglas Smith
compiling information for this
employees of the Forest Service.

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Timber is only one of the important products and services that the Nation derives from its forests. Forests also provide such products as minerals, wildlife, fish, water, and forage, and such diverse services as outdoor recreation opportunities and wilderness experiences. Although all of these various products and services are vital to the quality of life and national well-being, timber is the major consumable product of the forest and the primary source of forest revenues. It is also one of the Nation's most important industrial raw materials, manufactured into and consumed in many forms for many purposes ranging from housing, furniture, and toys to paper, Christmas trees, and fuelwood.

Because of its widespread use, timber is an important contributor to the U.S. economy. In 1958, about 5.6 percent, or about $1 of every $18, of the Nation's gross national product (GNP)—the value at current market prices of all goods and services produced by the Nation's economy—originated in some kind of timber-based economic activity. Employment attributed to timber amounted to the equivalent of 3.3 million people or about 1 out of every 20 persons employed.

Since the 1950's, there have been many changes in the management, harvest, manufacture, distribution, and use of timber and its products. Productivity has improved in all phases of the timb which data are available, new pro oped, the relative importance of shifted, industrial production modified, methods and means o been altered, relative price relatio and nontimber products have cha and consumption of nearly all tim creased. Because of these various f the Nation's economy has change signed to measure this change by es tribution to national, regional, and ty in 1963, 1967, and 1972. The re are the same as those used for mos Surveys and are shown in figure 1

Gross national product and tota are two of the most widely accepte economic activity. Both of these the sums of the contributions of and other economic enterprises a consequence, the amounts of GNP inating in timber-based economic vide a meaningful estimate of the tance of timber.

Figure 1

Study Regions

For purposes of this study, and to facilitate comparisons with earlier studies, timber-based economic activities have been categorized as follows:

1. *Timber management.*—Activities involved in improving, protecting, and otherwise managing forest lands for the production of timber and related products.

2. *Harvesting.*—Activities involved in harvesting and transporting logs and related products from forests to local points of delivery.

3. *Primary manufacturing.*—Activities involved in the processing of logs and related products into lumber, veneer, plywood, pulp and paper, turpentine, rosin, and other products.

4. *Secondary manufacturing.*—Activities involved in the remanufacture of lumber, plywood, paper, and other products into finished goods such as furniture, toys, wearing apparel, and containers.

5. *Construction.*—Activities involved in the fabrication of lumber, plywood, and wood-based building board into houses, nonresidential buildings, and other fixed structures.

6. *Transportation and marketing.*—Activities involved in the transportation of logs and related products from local delivery points to manufacturing plants or other consumers, transportation of primary and secondary products from points of manufacture to final consumers, and the marketing of these products through wholesale and retail channels.

In order to estimate the contribution of each of these activities to total GNP, the economic concept of value added was used. Value added is defined as the difference between the value of goods produced by an enterprise

timber- and nontimber-based
handled, only a portion of t
employment were attributed t
prises, estimates of total valu
and of value added and emplo
are presented. The sum of the
ment attributed to timber is c
part of the GNP and national
timber-based economic activiti

As shown in the table footn
and employment for the man
derived from the 1963, 1967
Manufactures. For these indus
estimates of value added and
timber could be derived by us
cost of timber products as a
cost of all raw materials that
final product. For example, in
niture industry—where lumbe
veneer, and other wood-based
60 percent of the total cost of
percent of the total value adde
tributed to timber. The rema
tributed to glass, plastics, meta
wood materials used in maki
contrast, only about 5 percen
employment in metal househo
to timber and 95 percent to ot

In some secondary manufa
ances were made for nontim
earlier processing stages. For e
the cost of the paper and pape
in the allocation of value adde
maining 15 percent of the cost
put was considered to be allo
bagasse, clay, or other nontim
paper and paperboard manufa
ing stages.

In some manufacturing ind
tion on value of materials cons
those cases, estimates of value

estimates of value added or employment were computed, nor was an attempt made to show total value of product shipments. However, estimates of the aggregate value added and employment attributed to timber in such industries were made. These were based on estimated volumes of timber-based materials consumed in these industries and on the ratios of value added and employment attributed to timber per unit of wood consumed in those secondary manufacturing industries in which timber composed more than 2.5 percent of materials cost.

Estimates of value added and employment attributed to timber in construction were derived by multiplying estimates of total value added and employment by the ratios of cost of timber products construction materials to cost of total materials by type of construction. For the transportation and trade sectors, estimates of value added and employment attributed to timber were derived by multiplying estimates of total value added and employment by the ratio of freight revenue from timber products and total freight revenue, and sales of timber products and total sales, respectively.

Although this study measures some of the same factors (value added and employment) measured in input-output studies and used in the construction of input-output tables, it is not an input-output study. As a consequence, no interindustry transactions matrix has been constructed and it is not possible to measure, for example, the effects on the timber-based sectors of a change in final demand through the use of multiplier analysis. In addition, interstate, interregional, and international flows of mate-

rials between sectors have not
although the statement can be c
every dollar of stumpage cut in a
ditional *X* dollars of value is adde
economic activities, it should not
ditional value added has been ge
that State or region.

The data used in this study ha
great number of diverse sources.
necessary to make estimates for S
averages, or for regions based or
quently, the more aggregative da
most reliable. In others, such as
harvesting, the Standard Industria
for establishments was departed f
activity-oriented approach. This
in the primary manufacturing data
suses of Manufactures, partly on
discussed in the primary manufa
also necessary, for some items, to
on trends when data for 1963, 1
available. Finally, because the Na
is dynamic and changes from y
parent trends shown by the data m
porary changes in the overall econ
tural changes in the timber ec
limitations, it is believed that the
the report will provide a more con
the importance of timber and tin
the Nation's economy.

Highlights

The estimated stumpage value of the timber cut in the United States in 1972 was about $2.9 billion (table 1), more than double the estimated $1.3 billion harvest in 1963. The timber products harvested from this stumpage, along with related products such as Christmas trees and pine gum, were valued at $6.4 billion. In total, about 307,000 were employed in timber management and harvesting in 1972.

The net contribution to the GNP of the enterprises included in this study is shown in terms of value added—the difference between the costs of goods purchased by an enterprise and value of products sold. All of the values added and employment in timber management and in harvesting were considered to be timber-based and thus were attributed to timber. However, in those enterprises in manufacturing, construction, transportation, and trade, where both timber and nontimber materials were used or handled, only a part of the total value added and employment originated in timber-based activities and was attributed to timber.

The value of shipments from primary manufacturing industries (sawmills and planing mills; veneer and plywood plants; pulp, paper and paperboard mills; and other primary manufacturing plants such as cooperage-stock mills and particleboard plants) amounted to $23 billion in 1972. Value added in primary manufacturing amounted to $10.1 billion and that attributed to timber to $8.8 billion. Total employment in primary manufacturing was 488,000. Of that total, 427,000 was attributed to timber.

Shipments from selected sec
dustries (paper and paperbo
millwork and prefabricated wo
containers industries) totaled
added attributed to timber in t
to $12.5 billion in 1972. Emplo
totaled 900,000.

In construction, the total va
(as measured by construction
$159 billion. Total value added
and that attributed to timber $
in construction was an estimat
795,000 attributed to timber.

The total value added in tran
was an estimated $194.2 billic
this was attributed to timber. T
million, that portion attributed

Overall, the value added in
economic activities was almost
about 4.1 percent of the Natio
tributed to timber in 1972 was a
4.0 percent of all civilian en
States. In 1963, about 4.4 per
percent of total employment we
based.

imated value of product or service, total value added and employment, and value added and employment attributed to timber in timber-based economic activities in the United States, 1972, 1967, and 1963

ty	1972					1967					1963				
	Value of product or service[1]	Value added		Employment		Value of product or service[1]	Value added		Employment		Value of product or service[1]	Value added		Employment	
		Total	Attributed to timber	Total	Attributed to timber		Total	Attributed to timber	Total	Attributed to timber		Total	Attributed to timber	Total	Attri to ti
	Million dollars	Million dollars	Million dollars	Thousand employees	Thousand employees	Million dollars	Million dollars	Million dollars	Thousand employees	Thousand employees	Million dollars	Million dollars	Million dollars	Thousand employees	Thou empl
nt	2,864	2,864	2,864	117	117	1,470	1,470	1,470	108	108	1,336	1,336	1,336	95	[illegible]
	6,360	3,065	3,065	190	190	3,540	1,762	1,762	236	236	3,220	1,533	1,533	277	[illegible]
uring:															
anning mills	7,575	3,029	2,876	184	171	4,177	1,526	1,449	189	178	3,748	1,320	1,254	210	[illegible]
vood plants	2,923	1,238	1,073	66	58	1,687	649	584	70	63	1,340	529	476	63	[illegible]
d paperboard															
	11,705	5,417	4,583	218	184	8,823	4,341	3,454	230	184	7,031	3,459	2,932	216	[illegible]
	815	384	264	20	14	334	151	141	13	12	309	142	132	14	[illegible]
	23,018	10,069	8,797	488	427	15,021	6,666	5,629	502	438	12,428	5,450	4,794	502	[illegible]
cturing:															
refabricated															
s	8,085	3,127	1,951	219	137	3,291	1,245	779	125	78	2,387	913	599	107	[illegible]
ners	774	359	324	37	33	530	239	197	31	26	402	174	146	31	[illegible]
	10,111	5,395	1,820	423	151	6,880	3,658	1,375	387	154	5,295	2,746	1,024	346	[illegible]
rboard products	16,553	7,605	5,063	413	278	12,147	5,374	3,626	405	276	9,326	3,903	2,698	368	[illegible]
and textiles	—	17,513	2,629	1,652	249	—	15,403	2,189	1,788	254	—	11,519	1,762	1,649	[illegible]
	—	—	718	—	52	—	—	600	—	63	—	—	409	—	[illegible]
	—	—	12,504	—	900	—	—	8,766	—	851	—	—	6,639	—	[illegible]
	159,000	79,601	11,947	5,278	795	102,400	49,970	6,733	4,532	556	85,300	41,139	6,237	4,351	[illegible]
d marketing:															
	—	32,070	2,792	1,899	165	—	21,233	1,835	1,849	177	—	17,063	1,837	1,851	[illegible]
	684,300	70,466	2,997	4,310	181	459,500	44,037	1,761	3,641	144	358,400	34,074	1,573	3,227	[illegible]
	470,800	91,635	3,561	12,498	489	310,200	61,624	2,813	11,005	514	244,200	45,811	2,130	9,956	[illegible]
	—	194,171	9,287	18,707	835	—	126,894	6,409	16,495	835	—	96,948	5,540	15,034	[illegible]
es	—	—	48,464	—	3,265	—	—	30,768	—	3,024	—	—	26,079	—	[illegible]

Timber Management

For purposes of this study, timber management is defined as the process of improving, protecting, and otherwise managing forest lands for the production of timber and related products. It includes such activities as timber stand improvement; tree planting; protection of forests from fire, insects, and other destructive agents; timber sales activities; and education, consultation, planning, and research related to timber management and timber products.

Timber management activities have grown rapidly during the past few decades as public resource agencies and timber industries have expanded and intensified their programs. In addition, through various public and private educational and technical assistance programs, nearly all landowners have been afforded the opportunity to manage their timber resources more effectively. Moreover, nearly all U.S. commercial timberland is now protected against wildfires by some type of organized fire control program. As a result of these various measures, most of the timber currently harvested in the United States represents to some degree the product of management.

Timber harvest about 11.9 billion cubic feet in 1972

In 1972, some 11.9 billion cubic feet of timber was harvested from U.S. forests (table A-1, fig. 2). This represented an increase of about 12 percent from production in 1963, and 7 percent more than in 1967.

About 47 percent of the total cut (5.6 billion cubic feet) came from forests in the South, 40 percent (4.7 billion cubic feet) from the West, and 13 percent (1.5 billion cubic feet) from the North. For the South, the cut in 1972 represented a large increase since 1963, both in volume and proportion of the U.S. total. The volume cut rose nearly 1.2 billion cubic feet, and the proportion of total increased by some 5 percent. The volume harvested in the West also increased, rising almost 0.4 billion cubic feet. However, the amount cut in 1972 represented a somewhat smaller percentage of the U.S. total than did

The volume of, regional dis
timber harvests are due to a n
ing demand and supply factor
hardwood timber, over half
northern forests in the late 196
over the past three decades. C
wood timber, largely a produ
forests, have increased. Tim
ownership pattern's, and indu
have also been important. C
pected as the relative importa
change.

Value of stumpage c
$2.9 billion

The stumpage value of the t
in 1972 is estimated at abou
double the value in 1963 and 9
A-1, fig. 2). This sharp incre
result of not only the rise in vo
even larger jump in average v
ulation below, average value
all stumpage cut was about $2
percent above the 1963 avera

Region	1972
	(do
North	11.72
South	17.07
West	36.48
United States	24.10

Although the total value of
the North, South, and West b
percentage contribution of e
changed markedly. For exam

somewhat smaller size and lower quality. As a result of these factors, average stumpage price in the West doubled between 1963 and 1972, southern prices increased about 83 percent, and prices in the North rose 56 percent (see tabulation above). Most of the rise in all regions came between 1967 and 1972.

In this study, it has been assumed that the value of stumpage cut is the same as the total value added and the value added attributed to timber management activities. There are undoubtedly some costs for intermediate products used in timber management, such as supplies used in planting and fire control that conceptually should be deducted. However, much of the activity involved is labor intensive, and the data available indicate that the intermediate product costs are relatively small in comparison with the value of stumpage cut. Consequently, no deductions were made.[1]

Employment in timber management activities 117,200 in 1972

The equivalent of about 117,200 people is estimated to have been employed in timber management activities in 1972 (table A-2). This total includes estimates of the

[1] Hair, Dwight. The economic importance of timber in the United States. U.S. Dep. Agric. For. Serv. Misc. Publ. 941, 91 p. 1963.

full-time equivalent for part-time
land owners. Although no exact
estimated that about 20,000, or
were professional foresters. The
including that of forest owners
tasks such as firefighting, tree
sales and other management acti

Employment in timber mana
have increased about 24 perc
22,500 workers—between 1963 an
of this rise, about 13,000, came
and involved increases in both
employment. Between 1967 and
curred, particularly in Federal en

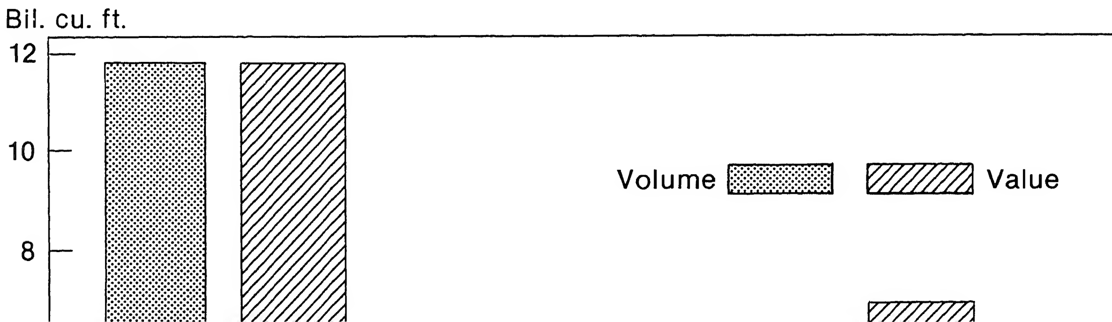
In all 3 study years, about
employment is estimated to hav
Federal, State, and local governm
13 percent in forest products ind

South first in timber mana

In 1972, as well as 1963 and 196
total employment was in the Nor
and the remaining two-fifths
Employment by the Federal gov
the West and timber-owner emp
East, because of existing land-ow

Figure 2

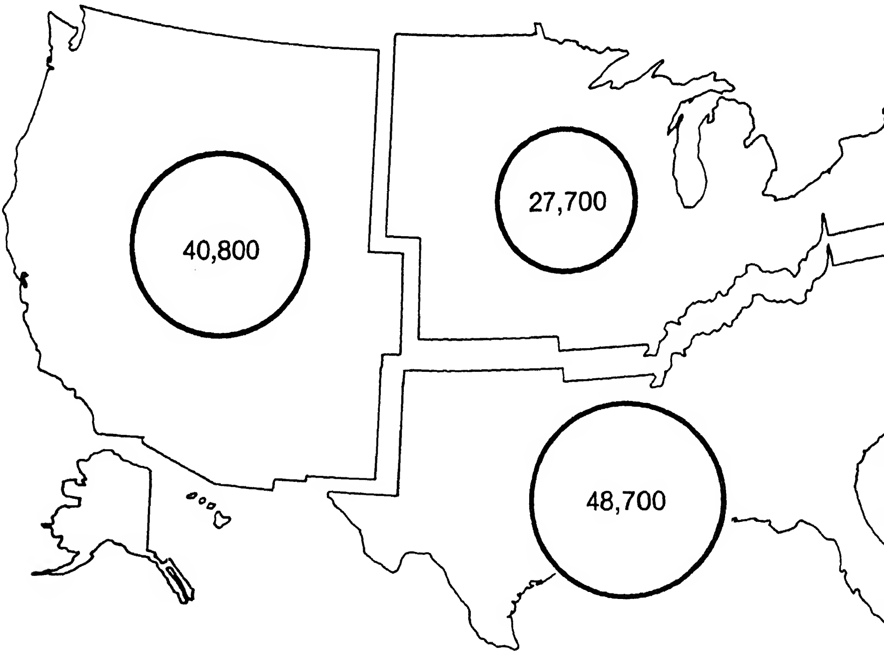
Volume and Value of Stumpage Cut, 1972



In so far as possible, estimates of employment in timber management were based only on those involved in activities directly related to the growing of trees for timber. However, timber management activities include many functions other than those directly related to the production of timber and to timber sales. The data presented here undoubtedly i that might better be attributed or some other forestry activity, tributable to timber productio page, all of the employment i tivities is attributed to timber.

Figure 3

Employment in Timber Management, 1972 (Total 117,200)



Harvesting

In this study, harvesting includes felling trees, cutting them into logs, cutting or collecting such miscellaneous timber products as Christmas trees and pine gum, and transporting these products to local delivery points such as rail yards, barge landings, and processing points.

Saw logs the most important product harvested

In 1972, about 5.9 billion cubic feet of saw logs, 3.6 billion cubic feet of pulpwood, 1.4 billion cubic feet of veneer logs, and 0.95 billion cubic feet of other round timber products such as cooperage logs, poles, piling, fuelwood, and fence posts were harvested from U.S. forests (table A-3, fig. 4). This represented an increase since 1963 of about 9 percent for saw logs, 52 percent for veneer logs, and 36 percent for pulpwood. Only the harvest of "other" timber products dropped during the period, mainly because of the continued decline in fuelwood output.

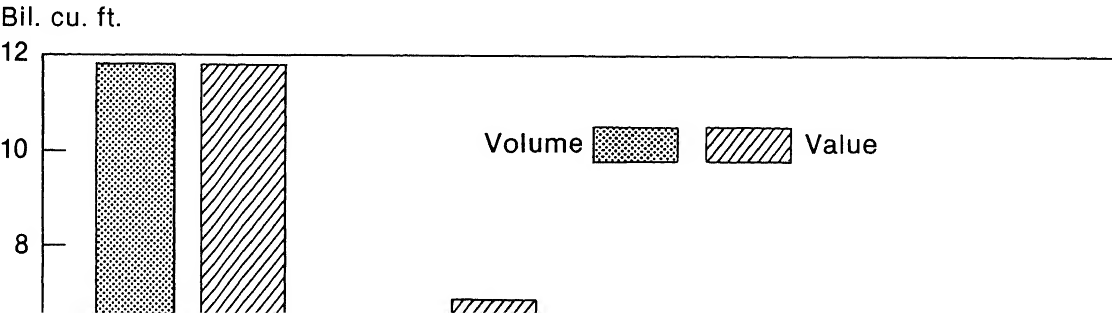
The South accounted for about 47 percent of the total roundwood harvest in 1972. This was up sharply from 42 percent in 1963 and was due to large increases in pulpwood and veneer log output and to a somewhat smaller rise in saw log production. Much of the over fourfold increase in veneer log production resulted from the rapid development of the southern pine plywood industry. About 72 percent of the total pu
from Southern forests in 1972, a
portion than in 1963. Over half c
wood products also was cut in the

About 4.7 billion cubic feet of
was harvested in the West in 1972,
national total and slightly below th
in 1963. The West produced the l
logs in all 3 study years. Most of t
the Pacific Coast States of Oreg
California. Output in the North d
cent between 1963 and 1972, pri
declines in the harvests of veneer lo
ucts. In total, about 13 percent o
wood output came from the Nor
less than the 16 percent produced

Oregon, Washington, and Calif
the harvest of both saw logs and v
1967. By 1972, however, with the
wood plywood industry in the Sou
the third leading veneer log produ
number one total producer of all
outside the Pacific region in 1972. l
saw log, veneer log, and pulpwood
had the largest volume of "other"

Figure 4

Volume and Value of Round Timber Products Harvested, 1972



The total value of round timber products harvested in 1972 is estimated at $6.3 billion (fig. 4) about 98.6 percent of the value of all products discussed in the following section.

Total value of timber products harvested in 1972 some $6.4 billion

The total value of timber and related products harvested from U.S. forests in 1972 was an estimated $6.4 billion (table A-4.) This was almost double the estimated value in 1963 and 80 percent larger than in 1967. The somewhat larger increase in total value than in timber products output during the study period was due to the rapid rise in average value for most products, particularly between 1967 and 1972.

In 1972, saw logs accounted for about 58 percent of the total value of the timber products harvested; veneer logs 21 percent; pulpwood 16 percent; and the "other" products such as fuelwood, poles, piling, pine gum and Christmas trees, the remaining 5 percent. This was somewhat different from the distribution in 1967 and 1963, when the total value of pulpwood harvested exceeded total veneer log value.

The West, which led all other sections of the Nation in total value of timber products harvested in each of the 3 study years, increased its share of the total from 52 to 55 percent between 1963 and 1972. This was primarily due to the relatively more rapid increase in average saw log and veneer log value for Pacific Coast species. The South was next in order of importance.

Value added in timber harvesting $3.1 billion in 1972

Employment in harvesti

In 1972, the equivalent
employed in timber harvesti
5). This was a decline of m
employment in 1963 and was
improvements in logging pro
as well as declines in some of
tivities such as pine gum gatl

The estimates of logging
are substantially larger than e
Logging Camps and Logging
2411) shown in the 1963, 1
Manufactures. This is because
and coverage. The Census e
employees of independent lo
excluded the logging employe
ing enterprises such as sawm
and other part-time loggers
harvesting such miscellaneous
estimates presented here, on t
by using timber products o
regional productivity factors
harvesting employment.

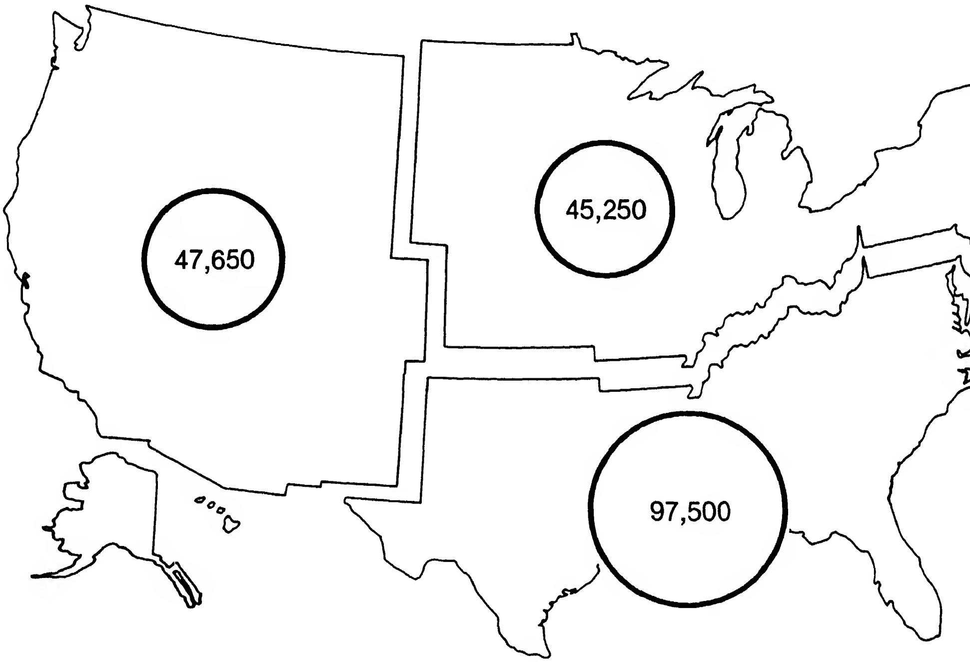
Over half of the 1972 ha the South

About 51 percent of the
harvesting in 1972 were emplo
the production of pulpwoo
Another 25 percent of those e
in the West and were largely
tion. Pulpwood production w
harvesting activity in the Nor
log harvesting.

The distribution of harvest
regions reflected both the vo
harvested and the differences

Figure 5

Employment in Timber Harvesting, 1972 (Total 190,400)



Primary Manufacturing

Some of the products harvested from the Nation's forests, such as fuelwood and Christmas trees, are ready for use and need only be marketed or transported to the final consumer. However, most, such as saw logs, veneer logs, and pulpwood, are manufactured into lumber, plywood, wood pulp, and other similar items.

This primary manufacturing is carried out in a group of enterprises that have been classified in this study as the **sawmills and planing mills industry; the veneer and plywood industry**; the pulp, paper and paperboard industry; and "all other"—a grouping of various enterprises manufacturing such diverse timber products as excelsior, wood shingles, cooperage stock, particleboard, and gum and wood chemicals.[2]

Lumber, plywood, woodpulp, and paper and board most important primary manufacturing products

The most important products of the primary manufacturing industries in 1972 were 31 billion board feet of softwood lumber, 6.8 billion board feet of hardwood lumber, 18.3 billion square feet (3/8-inch basis) of softwood plywood, 2.1 billion square feet (3/8-inch basis) of hardwood plywood, and 46.8 million tons of woodpulp (tables A-8, A-9, and A-10). In addition, these industries produced about 59.5 million tons of paper and board (mostly from woodpulp); 3.1 million square feet (3/4-inch basis) of particleboard; 1.6 million drums of rosin (520 pound net basis); 566,000 barrels (50 gallon basis); 531,000 tons of charcoal briquets; and numerous other products.

For most products, the volume produced in 1972 represented substantial increases over output in 1967 and 1963. For example, between 1963 and 1972 particleboard production increased sixfold, softwood plywood production 79 percent, woodpulp production 55 percent, paper and board 52 percent, hardwood plywood 25 percent, and softwood lumber 12 percent. The only solid wood product to exhibit a decline was hardwood lumber with a

duced in the West in 1963
however, the proportionate
South was dramatic after p
region in 1964. About 63 pe
production and 43 percent of
were from mills in the South i
this represented a slightly s
1963. Hardwood lumber prod
to the North, while the West
portion of hardwood plywoo
both the other two regions. T
a large domestic hardwood ti
and was presumably based pri

Of the other major primary
of the woodpulp, 49 percent
nearly all of the naval stores
woodpulp and particleboard,
proportions than in 1963.

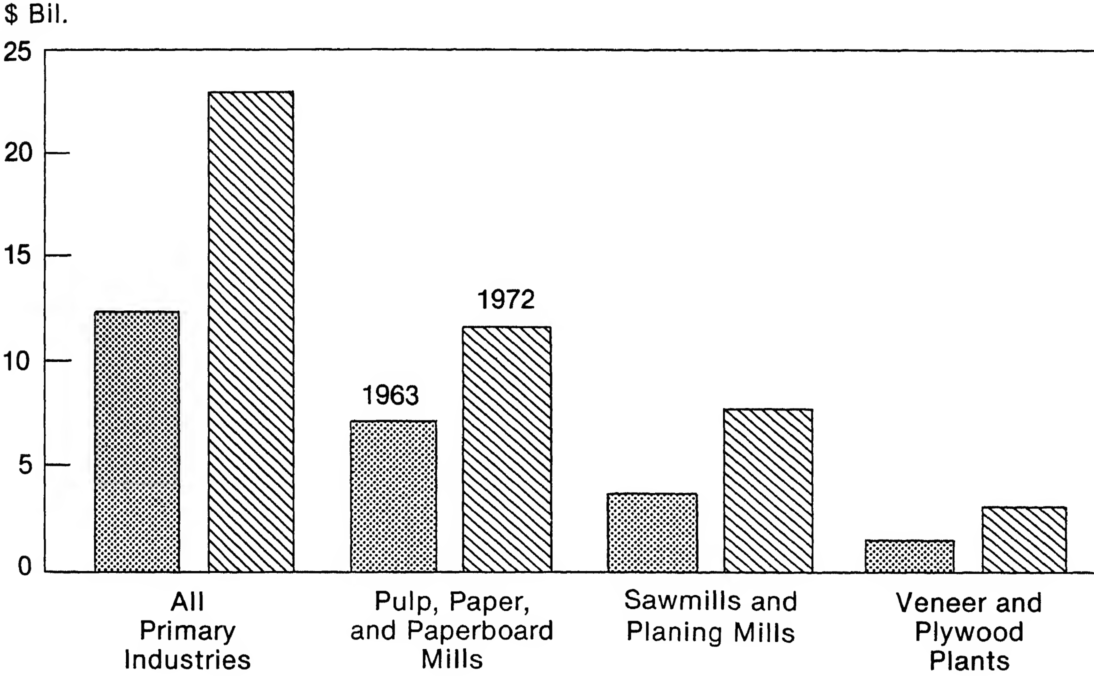
Value of products shipp
manufacturing industrie

The total value of products
manufacturing industries in
billion (table A-11). This was
$12.4 billion shipped in 1963
These increases were due to th
ing the study period and to
volume of product shipments
dollars, total value of shipmen
facturing industries increased
1963 and 1972.[3]
cent—reflects increases in pro

Unlike value added, value
primary manufacturing indus
ing because products of one m
as raw material to other plant
others classified in the primary
For example, the value of lum
to a plywood plant may be co

Figure 6

Value of Primary Manufacturing Shipments, by Industry, 1963 and 197



As shown in figure 6, the value of shipments from each of the primary manufacturing industry sectors increased between 1963 and 1972. This was also true in terms of constant dollars, reflecting the increases in physical output discussed earlier. Because product output and prices followed somewhat different trends among the various industries, the proportion of total shipments attributable to each industry in 1972 was somewhat different from that in 1963 and 1967. Over the total study period, value

Oregon and Washington led
value of shipments with a total of
$2.0 billion, respectively (table
Wisconsin had the highest totals f
Pacific region and were the only S
ceed $1.0 billion in total value of s
manufacturing industries.

The West led all other sections
of shipments from sawmills and

Value added in the primary manufacturing industries $10.1 billion in 1972

Part of the value of shipments from the primary manufacturing industries represents the cost of stumpage, logs, fuels, chemicals, and other intermediate products purchased from other sectors of the economy. When the costs of these products were deducted from the value of shipments, the value added in primary manufacturing amounted to an estimated $10.1 billion in 1972, up some 51 percent from 1967 and 85 percent above 1963 (tables A-13 and A-14).

As shown in the source notes to table A-13, these estimates of value added are somewhat below those given in the 1972, 1967, and 1963 *Censuses of Manufactures*, because of differences in definition and coverage. Data shown for primary manufacturing industries in Bureau of the Census publications include value added by logging operations when such operations are conducted by employees of the primary industry. For purposes of this study, the estimated value added in these logging operations was excluded from the totals for primary manufacturing. In addition, the value added for sawmills and planing mills in the East, as reported in the *Census of Manufactures*, was adjusted to include the estimated value added in small sawmills not covered by Census estimates. The combination of these two adjustments resulted in an estimated total value added for this study some $222.6 million below the Census data for 1972.

Value added attributed to timber $8.8 billion

The enterprises classified in the primary manufacturing industries based most of their manufacturing operations on timber products. For example, timber products composed about 95 percent of the cost of materials consumed in the sawmill and planing mills industry, and nontimber materials made up about 5 percent. In the veneer and plywood industry and in the pulp, paper, and paperboard industry, timber products accounted for about 87 percent

In 1972, about 52 percent o
to timber in the primary
originated in the pulp, paper,
7). Another 33 percent origina
mills, 12 percent in veneer a
percent in other primary man
distribution was somewhat d
primarily because of the char
shipments from the various i
in the volumes of timber pro
to all products consumed.

About 41 percent of the
timber in the primary manuf
originated in the South, up fr
percentage originating in the
1963-72 period, rising from
Most of the decline in the pe
North was due to the relati
veneer and plywood industry
paperboard industry in that s

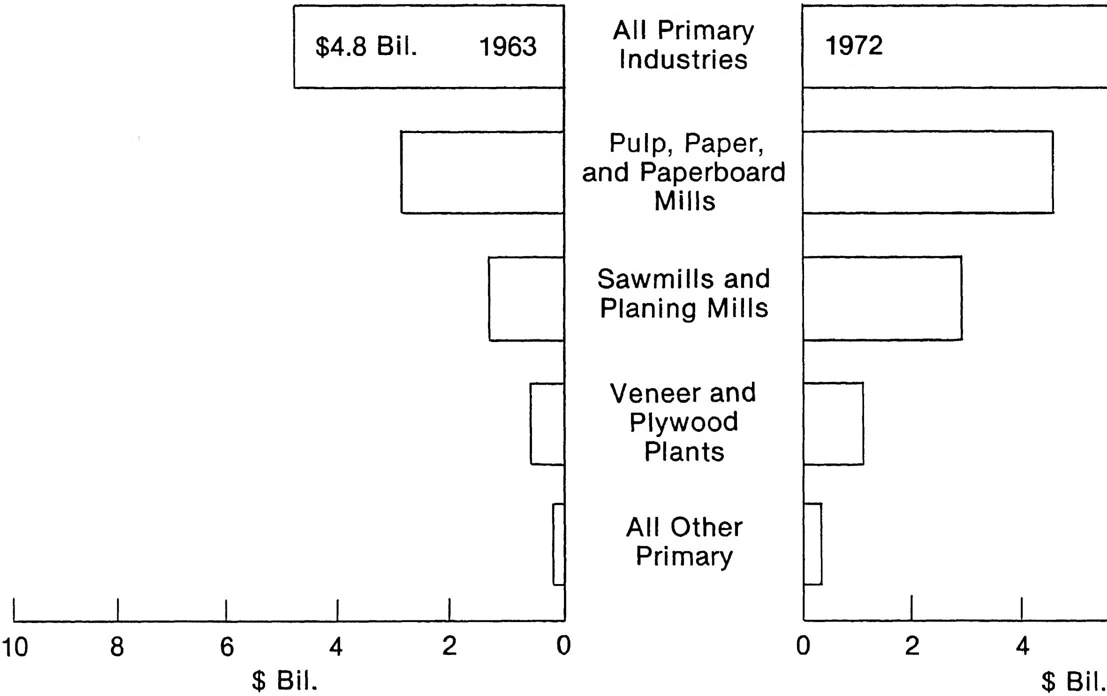
Value added attributed t timber input highest for paperboard mills

As shown in the following
attributed to timber per cubic
the pulp, paper, and paperbo
2.5 times the average for the
industry and 64 percent above
plywood plants. The primary
are differences in relative co
used in the manufacturing pr
cessing, and the value of pro

Industry   Value
timber p
c

Figure 7

Value Added Attributed to Timber in Primary Manufacturing, by Industr



Employment in primary manufacturing industries 487,900 in 1972

In 1972, some 487,900 persons were employed in the primary manufacturing industries (tables A-17 and A-18). This was about 3 percent below the total 502,400 employed in 1963. Although there was some variation, the trend over the entire study period was down for the sawmills and planing mills and slightly up for the veneer and plywood plants and the pulp, paper, and paperboard mills. The industries classified in "all other" showed an increase of about 46 percent between 1963 and 1972;

portant to the overall increase in
was the continuing decline in the n
tively less efficient mills, partic
Although no exact numbers are ava
indicate that as many as 10,000 of
gone out of existence during the st

There were also significant increa
the veneer and plywood industry
and paperboard industry between 1
ing in only modest increases in emp
rises in industry output. Bureau of

Employment attributed to timber in primary manufacturing 426,550 in 1972

As discussed earlier, most of the timber-based enterprises classified in the primary manufacturing industries based part of their manufacturing operations on non-timber materials. Because of this, only a part of the total employment in these industries was attributed to timber. This amounted to the equivalent of 426,550 people in 1972, down from a total of 437,500 in 1967 and 449,750 in 1963 (tables A-19 and A-20).

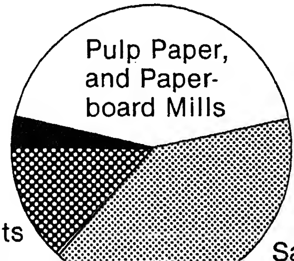
In 1972, about 43 percent of the employment attributed to timber in primary manufacturing was in pulp, paper, and paperboard mills (fig. 8). An additional 40 percent was in sawmills and planing mills, 14 percent in veneer and plywood plants, and 3 percent in "other" primary manufacturing. This was somewhat different from the distribution in 1963, when about 44 percent of the total was in sawmills and planing mills; 41 percent in pulp, paper, and paperboard mills; 13 percent in veneer and plywood plants; and 3 percent in "all other."

These distributions of employment were in large part determined by the relative volumes of wood processed, the degree of its processing, and trends in these factors. The degree of processing is particularly important in explaining the relatively large volumes of employment in the pulp, paper, and paperboard industry and the veneer

Figure 8

Timber-Based Employment in Primary Manufacturing, by Industry, 1972 and 1963

1972



and plywood industry. As sh
tion, the employment attrib
wood input was much larg
paperboard industry and th
dustry than in the sawmills a
both 1963 and 1972. In addit
tivity discussed earlier can b
number of employees per un

Industry	Nu at
Sawmills and planing mills	
Veneer and plywood plants	
Pulp, paper, and paperboard mills	
All primary manufacturing industries	

[1] Estimates derived by di
timber in each industry (table
duced by type of timber prod

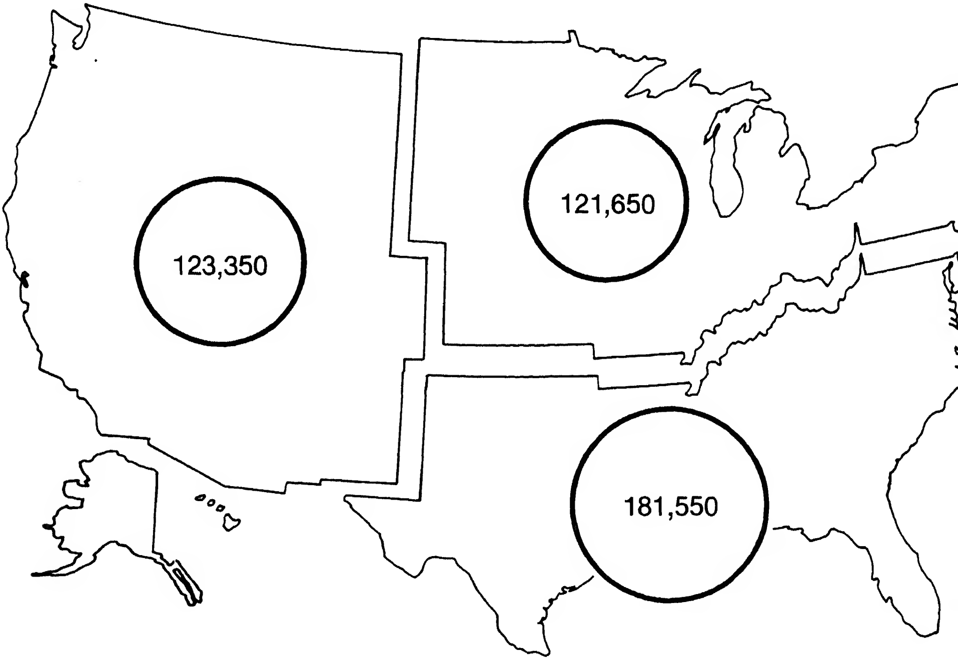
In 1972, about 43 percent
tributed to timber was in th
West (table A-19, fig. 9).
sawmills and planing mills
among the primary manu
paper, and paperboard mills
dustry employer in the Nort

Average value added p by industry and region

Because of differences in s
ess automation, scale of op
worker and managerial ski
rates, there is a great deal c

Figure 9

Timber-Based Employment in Primary Manufacturing, 1972 (Total 426,550)



Secondary Manufacturing

Many of the products produced by the primary manufacturing industries, such as newsprint, charcoal, and lumber and plywood for do-it-yourself use, are ready for marketing to final consumers. Other primary products, however, such as the dissolving grades of wood pulp, much of the paper and paperboard, and substantial volumes of lumber, veneer and plywood, and particleboard are further manufactured into wearing apparel, containers, furniture, and other consumer goods.

This secondary manufacturing is accomplished in groups of firms that have been classified for this study as the millwork and prefabricated wood products industry; the wooden containers industry; the furniture industry; the paper and paperboard products industry; the fibers, plastics, and textiles industry; and "all other"—a group which includes firms engaged in wood preservation, and in the manufacture of such diverse products as mirror and picture frames, shoe lasts, cork products, ships and boats, toys, and sporting and athletic goods.[4]

Shipments from selected secondary manufacturing industries in 1972 twice those in 1963

In 1972, the total value of shipments from the millwork and prefabricated wood products, wooden containers, furniture, and paper and paperboard products industries amounted to an estimated $35.5 billion (tables A-21 and A-22).[5]

About 47 percent of these shipments originated in the paper and paperboard products industry, 28 percent in the furniture industry, 23 percent in the millwork and prefabricated wood products industry, and 2 percent in the wooden containers industry.

Total value of shipments for these selected industries in 1972 was more than double the $17.4 billion in 1963. Although there were increases in shipments from each of the four industries during the study period, the millwork and prefabricated wood products industry showed the largest rise, more than tripling.[6]

Shipments from the wood
93 percent, from the furnitu
the paper and paperboard pr

Value of shipments was la
study years. However, ther
shifts between 1963 and 1972.
cent of the total shipments
dustries was in the North in 1
in 1963. During the same p
dustries in the South increase
cent of the total. Western sh
cent in both years.

Value added in selected manufacturing industrie

A substantial part of the v
secondary manufacturing ind
of materials, supplies, conta
plies and services purchased
dustries. When these costs we
of shipments, the value adde
manufacturing industries list
plastics, and textile industry a
1972, up about 77 percent f
mated for 1963 (tables A-2 a

In all 3 study years, the fib
dustry led the other selected s
added; however, its relative
about 60 percent in 1963 to
other industries showed some
for wooden containers which
of the total.

Value added attributed manufacturing $12.5 bil

The secondary manufactu
part of their manufacturing
ucts. In some enterprises, su

dustries to the total were somewhat different. In 1972, about 40 percent of the total originated in the paper and paperboard products industry. An additional 21 percent was added in the fibers, plastics, and textiles industry—mostly in firms engaged in throwing, spinning, and weaving rayon and in manufacturing rayon clothing. The millwork and prefabricated wood products industry accounted for another 16 percent, the furniture industry 14 percent, the wooden containers industry 3 percent, and "all other" secondary manufacturing industries about 6 percent. This was somewhat different from the distribution in 1963, when the millwork and prefabricated wood products industry composed only 9 percent of the total, and the fibers, plastics, and textiles industry 27 percent. The remaining industries showed relatively small changes.

Because of differences in the importance of timber products as a raw material in the various industries, the distribution of value added attributed to timber by industry was markedly different from that of total value added. For example, the value added attributed to timber was a relatively small part of the total value added in the fibers, plastics, and textile industry, a somewhat larger part in the furniture industry, and largest for the millwork and prefabricated wood products, wooden containers, and paper and paperboard products industries.

In 1972, about 52 percent of the
to timber in the secondary manuf
in the North, 36 percent in the So
West (table A-26). In 1963, the N
percent, the South 31 percent, an
These shifts were largely the result
growth for the various industries.
the North led in value added attri
of the six secondary industries, tra
the wooden container industry. I
South also led in the furniture, a
and textiles industries, and had s
the remaining two industry group

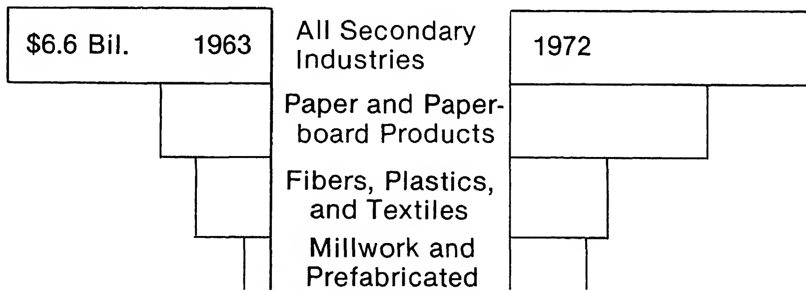
Employment in selected seco manufacturing industries 2.

Employment in all the second
dustries except the "all other" g
about 2.7 million in 1972, slightly
1967 and about 10 percent more
employed in 1963 (tables A-27 and
the total in 1972 was in the fibers,

[8] No attempt was made to compile to
other" secondary manufacturing grouping.
are used in most manufacturing industries,
a substantial part of all employment in ma
B).

Figure 10

Value Added Attributed to Timber in Secondary Manufacturing, by Industry, 1963 and 1972



dustry, and 15 percent each in the furniture industry and in the paper and paperboard products industry.

The South had the greatest number of employees in the selected secondary manufacturing industries in 1972, displacing the North which led in 1963. Among the various industries, the South was the largest employer in the fibers, plastics, and textiles industry, the furniture industry, and the wooden containers industry, while the North continued to lead in the millwork and prefabricated wood products industry and in the paper and paperboard products industry. In 1963, the North was the largest regional employer in all except the wood container industry.

Employment attributed to timber in secondary manufacturing industries 900,400 in 1972

In 1972, the employment attributed to timber amounted to an estimated 900,400 people (full-time equivalent) in the industries classified in the secondary manufacturing groupings (including employment attributed to timber in "all other") (tables A-29 and A-30). This was almost 50,000 more than in 1967 and up 14 percent from the 789,800 estimated for 1963. As discussed earlier, these estimates of employment attributed to timber were largely based on the relative cost of timber-based raw materials consumed.

About 31 percent of the total employment attributed to timber in 1972 originated in the paper and paperboard products industry (fig. 11). An additional 27 percent was in the fibers, plastics, and textiles industry, 17 percent in the furniture industry, 15 percent in the millwork industry, 4 percent in the wooden containers industry, and 6 percent in "all other" secondary manufacturing industries. These were about the same percentages as in 1963 for the paper and paperboard products, the furniture, and the wooden containers industries. The fibers, plastics, and textiles industry and the "all other" grouping, on the other hand, showed little change in total

Region	Relative shar attributed t manufa 1972 (percent)
North	48
South	41
West	11
All regions	100

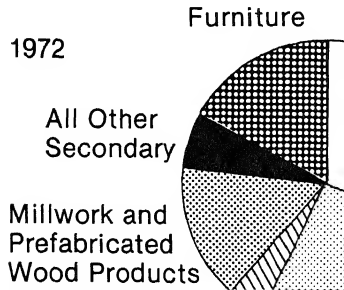
Among the various seco dustries, the North showed re the South and West in emplo in the millwork and prefabr paper and paperboard produ decline for the furniture; fiber "all other" industries.

Average value added per in the paper and paperb

The average value added siderably among the secondar For example, in 1972, the aver

Figure 11

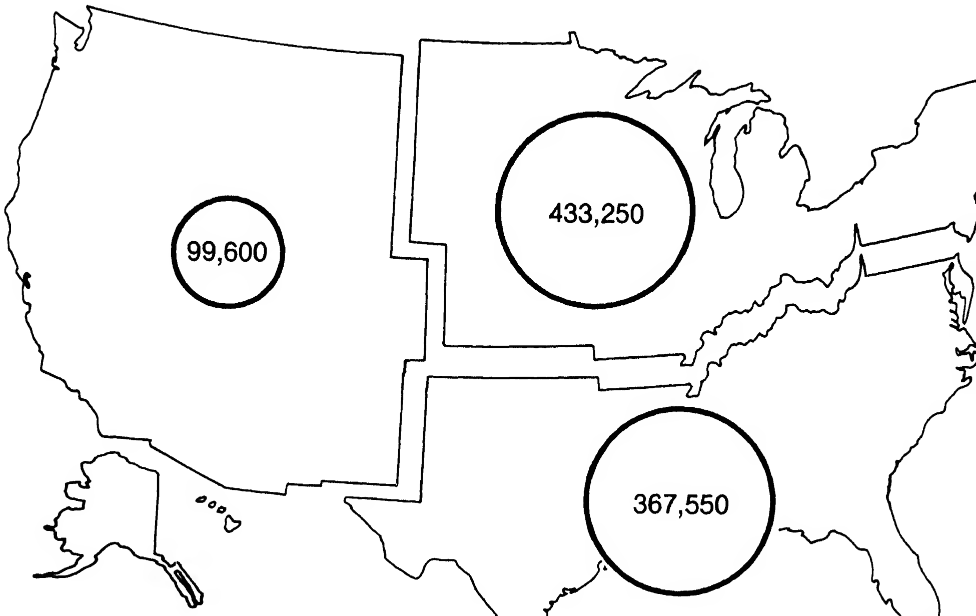
Timber-Based Employ Manufacturing, by Ind



board products industry was about $18,420—almost double the average $9,725 in the wooden containers industry. There was also a substantial range in averages between regions within the same industry. Most of these variations are due to such factors as regio ferences in worker and manageria process automation, capital invest operations.

Figure 12

Timber-Based Employment in Secondary Manufacturing, 1972 (Total 900,400)



Construction

Construction is the most important final use for timber products. Recent studies have shown that in the 1960's and early 1970's as much as three-fourths of the softwood lumber and plywood; a tenth of the pulp products; all of the poles, piling, and shingles; and significant quantities of other timber products consumed in the United States, were used in construction.

Construction, as defined for this study, includes the erection, maintenance, and repair of immobile structures and utilities, together with their integral service facilities. Structures include buildings, docks, bridges, railways, and other similar works that are built into or affixed to the land. Utilities are such things as electric light and power transmission lines, telephone and telegraph lines, sewers, and other similar facilities generally used for supplying services to individuals and establishments.

Value of construction an estimated $159 billion in 1972

Construction grew rapidly during the study period. The estimated total value of new construction and maintenance and repair construction was about $159.1 billion in 1972, up from $85.3 billion in 1963. The largest single construction component in terms of value was residential construction. In 1972, for example, nearly 44 percent of the total value of new construction put in place was attributable to private residential building (table A-31). Housing is also the most important construction sector in terms of wood products use. An estimated 41 percent of all of the softwood sawtimber products consumed in the United States in 1972 was used for new housing units. More than 95 percent of this was consumed in the 2.4 million housing units constructed on-site (table A-32).[9]

A substantial part of the expenditures for construction, and of the value of a firm's production, represents payments for construction work subcontracted to other firms and payments for materials, components, and supplies purchased from other sectors of the economy. When estimates of these costs (and receipts for land develop-

Value added attri
construction $11.9

The volume of co
value added in constr
the sections and regio
are marked difference
structures constructed
materials used to buil
shown that the cost o
as a percent of the to
equipment may vary
housing to 22 percent
as 0.8 percent for se
because of such fa
preferences, and regio
the kinds of materials
may be quite different
value added could be
of the various materia
to timber was estima
billion in 1967, and $

In 1972, about 46 pe
to timber was in the N
22 percent in the West
large gain since 1963 f
other two regions. Ca
counting for 11 percen
timber nationwide and
York, Florida, Texas,
importance.

Construction empl
795,250 attributed

In 1972, the equival
was engaged in const
increase of about 2
employed in 1963[10]

Figure 13

Value Added Attributed to Timber in Construction, by Region, 1963 an

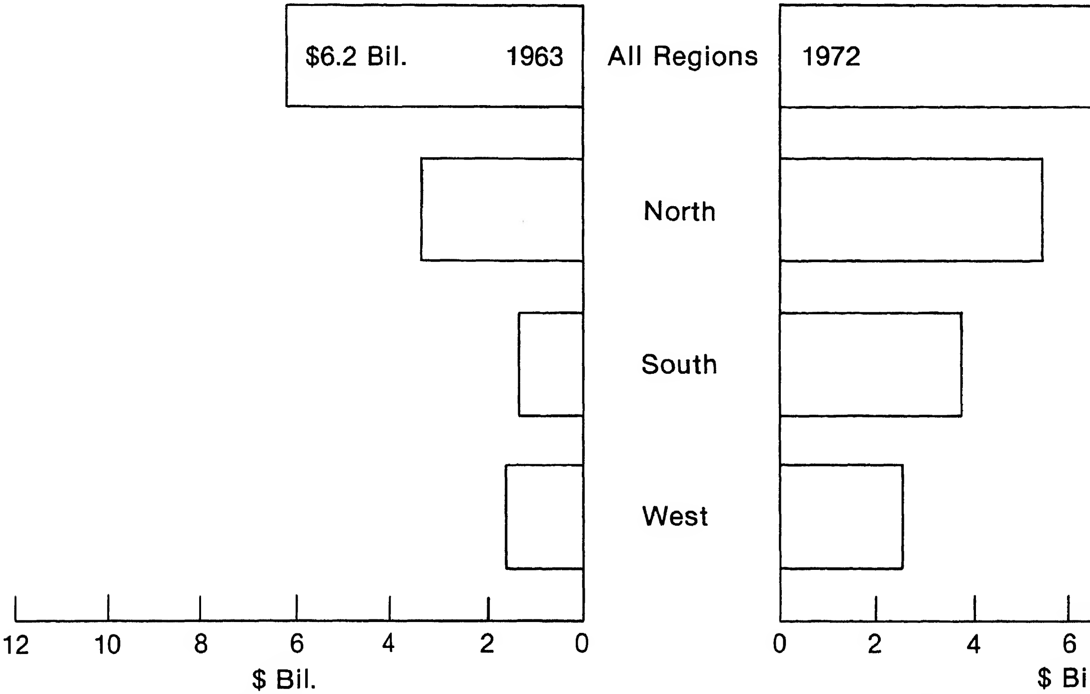
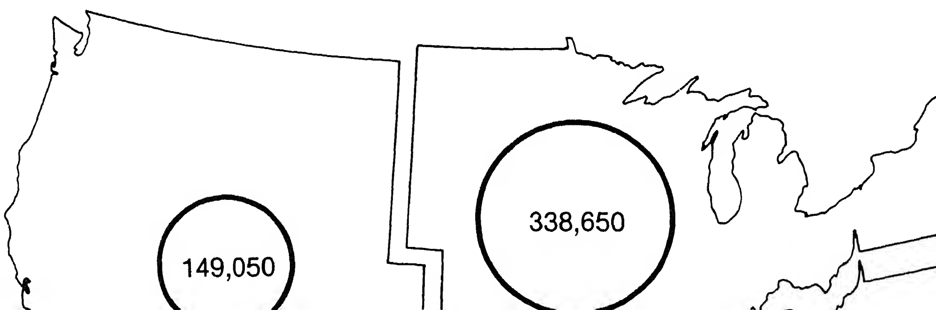


Figure 14

Timber-Based Employment in Construction, 1972 (Total 795,250)



Transportation and Marketing

The activities discussed in the earlier sections of this report have been concerned with producing and harvesting timber products and converting these products into finished goods. There are also other kinds of activities involved in preparing timber and related products for use by final consumers. These include transporting logs and other timber products from local points of delivery to manufacturing plants or consumers; transporting primary and secondary products from points of manufacture to final consumers; and marketing these products through wholesale and retail channels. These activities are carried on in a group of enterprises that have been classified as the railroad, truck, and water transportation industries, and the wholesale and retail trade industries.

Value added in transportation and marketing about $194 billion in 1972

The total value added in transportation and marketing amounted to an estimated $194 billion in 1972, up from $127 billion in 1967 and $97 billion in 1963. In all 3 years, more than four-fifths of the total originated in marketing, largely in the retail trade sectors (table A-35).

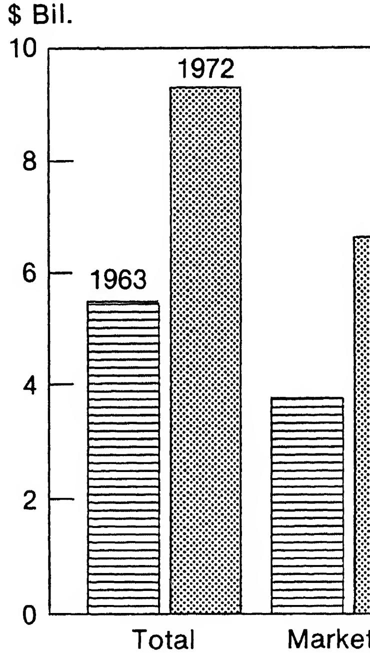
Value added attributed to timber in transportation and marketing, $9.3 billion in 1972

Only a relatively small part of the activity of enterprises in transportation and marketing was based on timber products. In the transportation industries in 1972, these products accounted for about 13.5 percent in railroad transportation, 10.3 percent in water transportation, and 5.7 percent in truck transportation. In wholesale trade and retail trade, sales of timber products accounted for slightly over and slightly under 4 percent, respectively, of total sales.

By assuming that value added attributed to timber products could be estimated from their relative proportion of total freight revenues or wholesale or retail sales,

Figure 15

Value Added Attributed Transportation and Mar 1972



56 percent was in the North and The Western proportion did no period.

Region	Value added transportat
	1972
	percen
North	50

By assuming that timber-based employment in transportation and marketing could be estimated from the proportion of freight revenue from or sales of the various timber products, the employment attributed to timber was calculated to total the equivalent of 835,150 employees in 1972, about the same as in 1967 and up some 4.3 percent from 800,400 in 1963.

Marketing accounted for four-fifths of the total combined employment attributed to timber in transportation and marketing in 1972. In all, 669,700 people were employed in timber-based marketing activities in 1972, up 10 percent from the 610,200 employed in 1963 (table A-40). Although there was some fluctuation, employment attributed to timber increased in both retail and wholesale trade during the study period.

Employment attributed to timber in transportation, on the other hand, declined between 1963 and 1972, dropping 13 percent to 165,450 (table A-39). Truck transportation registered an increase; however, both railroad and water transportation employment dropped sharply.

Because of a number of factors that include population patterns, industry locations, and resource availability, the employment attributed to timber in transportation and marketing varied somewhat between the major sections of the Nation. In 1972, for example, about 49 percent of the total was in the North, 32 percent in the South, and 19 percent in the
represented a substantial propo
South and decline for the North d
The percentage in the West showe

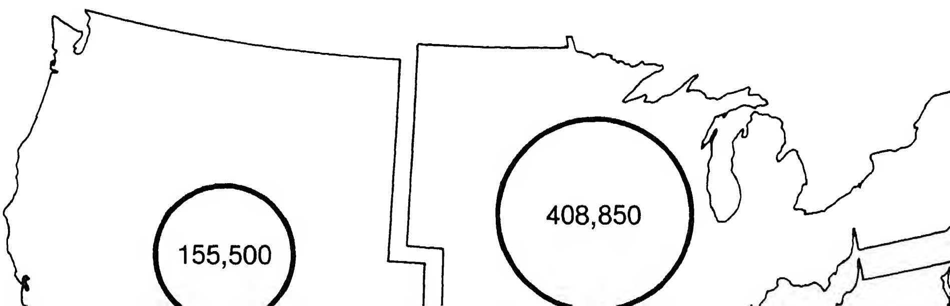
In 1972, the employment attribu
portation and marketing made u
the total employment in these com
from 5.3 percent in 1963. This
drops in the percentages both fo
trade and for truck and water tra

Average value added per em in railroad transportation, l

In 1972, average value added pe
tation and marketing ranged fr
$18,010 in railroad transportation
retail trade. There was also a su
average value added per employe
the country within the same indu
other industries, most of the varia
tors as regional and industry diff
manager skills, wage rate, capital
of operations.

Figure 16

Timber-Based Employment in Transportation and Marketing, 1972 (Total 835,150)



Conclusion

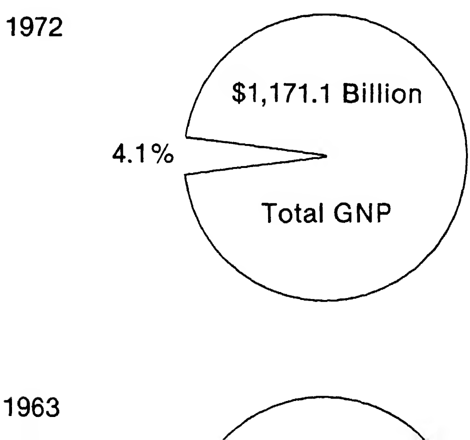
In the preceding sections of this report, estimates of value added and employment attributed to timber in the major timber-based economic activities have been presented. In this section and in table 1 shown on page 5, these estimates are combined and estimates of total gross national product and employment originating in all timber-based economic activities are presented.

About 4.1 percent of the Nation's GNP from timber-based economic activities

The sum of the values added attributed to timber in all kinds of timber-based economic activities amounted to about $48.5 billion in 1972 (tables A-41 and A-42). This represented about 4.1 percent of the Nation's GNP (fig. 17). This means that about $1 out of every $24 of the GNP originated in some type of timber-based economic activity. In 1963, the sum of the values added attributed to timber totaled $26.1 billion and composed 4.4 percent of the GNP.

Figure 17

Gross National Product Originating in Timber-Based Activities, 1972 and 1963

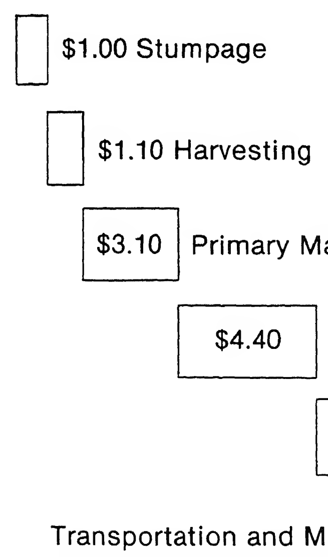


facturing, 25 percent in con
transportation and marketi
value added attributed to ti
1963 and 1967.

Looked at in another wa
show that in 1972, timber i
times between the stump an
based products to final c
average, to each $1 worth of
was added in harvesting, $3
ing, $4.40 in secondary m
struction, and $3.20 in trans
1967, the total increase was
$19.50.

Figure 18

Timber-Based Value
Stumpage Cut, by Ac



Among the various activities, value added in timber management and harvesting was highest in the West; in primary manufacturing in the South; and in secondary manufacturing, construction, and transportation and marketing in the North.

One of every 25 workers employed in timber-based economic activity

Employment (full-time equivalent) in all timber-based economic activities amounted to 3.3 million people in 1972 (tables A-43 and A-44). This represented about 4.0 percent of the total civilian employment in the United States in 1972 and means that about 1 out of every 25 people employed was engaged in some kind of timber-based economic activity (fig. 19). In 1963, the employment attributed to timber was 3.1 million, about 4.5 percent of total civilian employment.

Figure 19

Employment Originating in Timber-Based Activities, 1972 and 1963

1972

1963

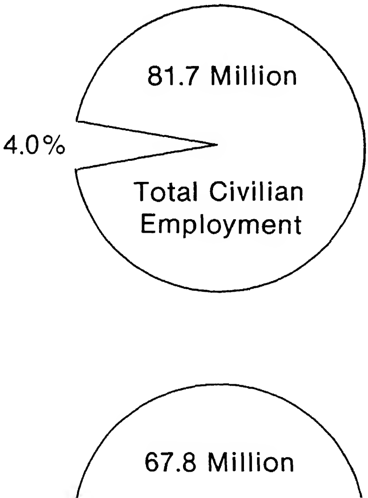
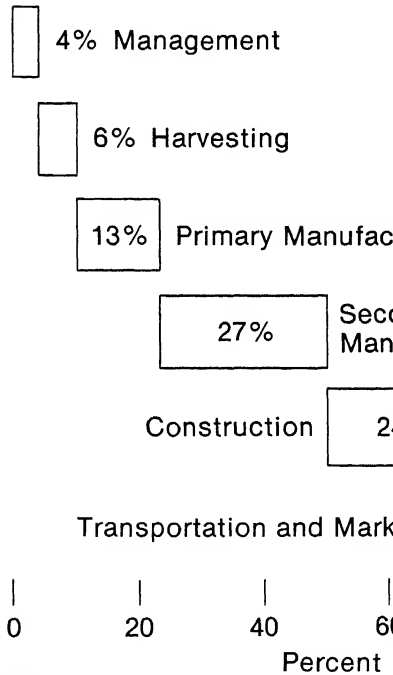


Figure 20

**Timber-Based Employme
1972**



marketing. These data on em
timber show that for each work
ment and harvesting, four were e
secondary manufacturing and
transportation, and marketing.

In 1972, 42 percent of the tota
to timber was in the North, 39 p
19 percent in the West. Califor
timber-based employment follow
sylvania, Texas, and North Car
other sections of the Nation in

Appendix A.
Tables

Region and State	1972 Volume[1]	1972 Value of stumpage cut	1972 Value added attributed to timber	1967 Volume[1]	1967 Value of stumpage cut	1967 Value added attributed to timber	Volun
	Thousand cubic feet	Thousand dollars	Thousand dollars	Thousand cubic feet	Thousand dollars	Thousand dollars	Thous cubic
North:							
Northeast:							
Maine	310,200	24,550	24,550	339,250	18,900	18,900	24
New Hampshire	50,750	5,800	5,800	42,600	2,900	2,900	4
Vermont	42,050	4,950	4,950	39,400	3,250	3,250	4
Massachusetts	14,250	2,450	2,450	31,650	2,200	2,200	2
Rhode Island	1,600	[2]	[2]	1,850	[2]	[2]	
Connecticut	6,000	850	850	11,900	750	750	1
New York	95,550	11,250	11,250	133,400	10,750	10.750	15
New Jersey	11,900	1,150	1,150	45,900	3,500	3,500	3
Pennsylvania	138,500	14,850	14,850	166,300	10,550	10,550	20
Total	670,800	66,050	66,050	812,250	52,900	52,900	78
North Central:							
Ohio	87,450	19,850	19,850	104,000	14,000	14,000	9
Indiana	45,000	8,250	8,250	58,750	7,150	7,150	4
Illinois	38,450	6,600	6,600	82,550	10,600	10,600	4
Michigan	201,000	21,100	21,100	197,700	15,200	15,200	21
Wisconsin	194,650	21,750	21,750	181,400	14,250	14,250	20
Minnesota	143,750	14,700	14,700	151,050	13,200	13,200	19
Iowa	22,900	3,200	3,200	20,950	1,650	1,650	2
Missouri	90,250	13,850	13,850	100,800	10,750	10,750	11
North Dakota	900	[2]	[2]	1,400	[2]	[2]	
South Dakota	14,050	1,000	1,000	17,450	800	800	
Nebraska	6,100	1,100	1,100	9,700	800	800	
Kansas	11,050	1,350	1,350	8,600	700	700	
Total	855,550	112,850	112,850	934,350	89,200	89,200	9
Total, North	1,526,350	178,900	178,900	1,746,600	142,100	142,100	1,73
South:							
Southeast:							
Delaware	8,900	1,300	1,300	13,650	950	950	
Maryland	48,250	9,900	9,900	46,700	5,500	5,500	6
Virginia	283,350	49,400	49,400	292,950	32,950	32,950	39
West Virginia	92,800	13,500	13,500	125,300	10,000	10,000	14
North Carolina	462,050	86,050	86,050	434,700	49,950	49,950	42
South Carolina	374,850	72,050	72,050	400,800	48,600	48,600	28
Georgia	732,200	129,750	129,750	644,100	72,400	72,400	57
Florida	273,250	45,000	45,000	254,550	29,500	29,500	22
Total	2,275,650	406,950	406,950	2,212,750	249,850	249,850	2,12
South Central:							
Kentucky	114,800	15,900	15,900	110,000	10,150	10,150	15
Tennessee	155,000	20,400	20,400	162,350	14,150	14,150	17
Alabama	801,800	123,050	123,050	711,200	65,150	65,150	48
Mississippi	610,900	95,250	95,250	483,650	44,850	44,850	37
Arkansas	540,400	93,500	93,500	466,400	47,450	47,450	42
Louisiana	642,400	114,150	114,150	531,750	58,150	58,150	38
Oklahoma	64,400	10,700	10,700	35,300	3,100	3,100	1
Texas	424,350	81,200	81,200	311,600	33,800	33,800	29
Total	3,354,050	554,150	554,150	2,812,250	276,800	276,800	2,34
Total, South	5,629,700	961,100	961,100	5,025,000	526,650	526,650	4,46
West:							
Mountain:							
Montana	280,300	62,750	62,750	274,400	24,750	24,750	20
Idaho	320,100	84,900	84,900	310,650	34,050	34,050	22
Wyoming	44,300	5,500	5,500	33,650	3,650	3,650	
Colorado	38,650	3,050	3,050	34,750	2,200	2,200	1
New Mexico	49,550	4,550	4,550	41,050	2,950	2,950	4
Arizona	87,450	13,350	13,350	95,150	11,200	11,200	6
Utah	9,850	900	900	10,950	750	750	
Nevada	2,800	[2]	[2]	5,550	[2]	[2]	
Total	833,000	175,100	175,100	806,150	79,800	79,800	6

Table A-2—Estimated employment in timber management in the United States, by region and State, 1

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	3,250	2,850	2,550
New Hampshire	800	750	700
Vermont	750	650	600
Massachusetts	900	900	900
Rhode Island	[1]	[1]	[1]
Connecticut	[1]	[1]	[1]
New York	2,600	2,400	2,050
New Jersey	600	500	[1]
Pennsylvania	2,850	2,600	2,400
Total	12,400	11,300	10,250
North Central:			
Ohio	1,400	1,300	1,200
Indiana	550	550	550
Illinois	1,700	1,600	1,550
Michigan	2,900	2,700	2,500
Wisconsin	3,050	2,700	2,500
Minnesota	1,850	1,800	1,700
Iowa	[1]	[1]	[1]
Missouri	2,100	1,950	1,850
North Dakota	[1]	[1]	[1]
South Dakota	600	[1]	[1]
Nebraska	[1]	[1]	[1]
Kansas	[1]	[1]	[1]
Total	15,300	14,250	13,000
Total, North	27,700	25,550	23,250
South:			
Southeast:			
Delaware	[1]	[1]	[1]
Maryland	1,000	900	800
Virginia	3,500	3,100	2,800
West Virginia	1,700	1,500	1,350
North Carolina	4,350	3,850	3,450
South Carolina	2,950	2,700	2,550
Georgia	6,650	6,000	5,500
Florida	5,100	4,550	4,050
Total	25,300	22,700	20,650

Region and State	1972
South Central:	
Kentucky	2,250
Tennessee	3,000
Alabama	3,800
Mississippi	3,900
Arkansas	3,400
Louisiana	3,600
Oklahoma	900
Texas	2,550
Total	23,400
Total, South	48,700
West:	
Mountain:	
Montana	3,400
Idaho	2,450
Wyoming	500
Colorado	1,600
New Mexico	950
Arizona	1,050
Utah	1,250
Nevada	[1]
Total	11,650
Pacific:	
Washington	5,600
Oregon	7,800
California	13,550
Alaska	1,950
Hawaii	[1]
Total	29,150
Total, West	40,800
Total, United States	117,200

[1] Less than 500 employees.

Note: Estimates of the number of temporary employees and forest landowners engaged in timber management activities have been converted to a full-tin
number of professional foresters employed; however, information from the *Journal of Forestry*, the *Economic Importance of Timber in the United States* a
the total 117,200 persons employed in 1972 were professional foresters.

Sources: Estimates of the full-time equivalent of the number of employees engaged in timber management activities were derived from data published in the
the Census, 1960 and 1970 *Censuses of Population*, the *Journal of Forestry*, the *Economic Importance of Timber in the United States* and from data in
Bureau of Land Management, U.S. Department of the Interior, and the Forest Service, U.S. Department of Agriculture.

72			1967					1963				
Veneer logs	Pulpwood	Other products[1]	Total	Saw logs	Veneer logs	Pulpwood	Other products[1]	Total	Saw logs	Veneer logs	Pulpwood	Other products[1]
6,100	200,400	19,500	339,250	72,700	6,400	238,250	21,900	241,400	45,550	7,800	172,050	16,000
350	17,050	2,900	42,600	16,900	1,000	19,800	4,900	43,050	20,400	1,150	14,400	7,100
1,100	11,500	9,700	39,400	19,200	1,800	10,700	7,700	49,700	27,700	1,800	12,450	7,750
150	1,200	650	31,650	13,750	300	1,750	15,850	26,550	12,300	200	2,050	12,000
[2]	400	500	1,850	500	[2]	650	700	3,400	1,050	[2]	650	1,700
[2]	750	1,800	11,900	3,200	50	1,150	7,500	19,450	3,600	50	1,250	14,550
2,100	33,200	16,650	133,400	56,050	3,450	31,550	42,350	159,200	49,000	2,750	33,350	74,100
100	2,300	4,850	45,900	13,900	200	3,800	28,000	33,300	4,600	200	4,900	23,600
1,950	46,500	20,150	166,300	67,650	2,100	52,050	44,500	204,850	87,400	3,050	40,950	73,450
11,850	313,300	76,700	812,250	263,850	15,300	359,700	173,400	780,900	251,600	17,000	282,050	230,250
1,100	18,450	17,050	104,000	61,550	1,050	22,200	19,200	90,200	52,500	1,300	17,800	18,600
1,800	6,100	7,500	58,750	37,450	2,150	5,450	13,700	49,450	25,100	2,500	5,950	15,900
800	4,600	8,950	82,550	27,600	1,050	5,450	48,450	44,650	24,000	1,400	7,650	11,600
2,500	99,400	31,300	197,700	53,700	3,200	100,850	39,950	215,650	58,050	2,350	96,150	59,100
3,150	111,900	29,800	181,400	45,100	3,700	103,050	29,550	201,550	36,100	3,850	91,250	70,350
600	100,000	21,200	151,050	25,750	900	92,300	32,100	190,450	50,800	1,500	81,350	56,800
1,150	2,450	10,300	20,950	6,950	950	2,150	10,900	22,250	6,150	1,000	1,450	13,650
700	4,050	45,650	100,800	50,450	900	1,650	47,800	111,450	40,250	900	1,600	68,700
[2]	[2]	700	1,400	300	[2]	[2]	1,100	1,500	100	[2]	[2]	1,400
[2]	3,550	3,650	17,450	6,750	[2]	3,650	7,050	7,450	50	50	2,650	4,700
300	100	1,550	9,700	5,250	100	[2]	4,350	8,150	3,250	50	[2]	4,850
450	3,400	4,750	8,600	3,150	450	[2]	5,000	8,300	950	850	[2]	6,500
12,550	354,000	182,400	934,350	324,000	14,450	336,750	259,150	951,050	297,300	15,750	305,850	332,150
24,400	667,300	259,100	1,746,600	587,850	29,750	696,450	432,550	1,731,950	548,900	32,750	587,900	562,400
1,150	3,550	1,600	13,650	1,900	1,250	7,250	3,250	9,750	4,400	900	1,900	2,550
4,250	11,400	3,150	46,700	21,750	4,050	14,250	6,650	63,500	36,850	3,600	11,050	12,000
18,400	123,900	32,900	292,950	112,800	12,400	140,500	27,250	396,400	180,300	6,900	132,000	77,200
700	14,100	17,100	125,300	60,950	1,000	24,650	38,700	144,650	66,900	1,050	23,150	53,550
34,050	224,350	36,550	434,700	158,250	24,650	181,000	70,800	420,850	169,950	21,350	140,550	89,000
25,550	188,500	38,150	400,800	154,200	13,000	174,100	59,500	283,900	71,950	12,800	150,050	49,100
30,700	444,250	39,350	644,100	178,650	20,700	401,500	43,250	579,900	166,350	19,600	350,900	43,050
15,400	214,300	7,000	254,550	30,650	13,000	191,550	19,350	228,150	24,100	12,950	166,700	24,400
30,200	1,224,350	175,800	2,212,750	719,150	90,050	1,134,800	268,750	2,127,100	720,800	79,150	976,300	350,850
900	13,100	32,150	110,000	69,650	1,300	7,000	32,050	155,200	96,650	1,700	5,550	51,300
1,450	36,450	31,450	162,350	93,900	1,350	27,100	40,000	179,800	92,000	1,900	30,300	55,600
59,750	440,500	68,250	711,200	211,300	33,250	386,150	80,500	483,150	169,150	11,100	228,850	74,050
61,400	286,000	73,900	483,650	173,900	33,500	189,150	87,100	371,250	139,400	7,900	131,000	92,950
63,300	171,900	63,000	466,400	232,850	39,500	117,750	76,300	425,250	221,950	3,900	104,300	95,100
12,100	255,550	40,800	531,750	249,300	69,750	165,450	47,250	381,050	176,200	8,050	149,550	47,250
6,950	23,050	6,500	35,300	14,550	550	4,750	15,450	53,850	19,000	100	1,950	32,800
70,950	177,700	22,400	311,600	129,850	28,250	113,900	39,600	293,300	146,150	6,550	80,700	59,900
76,800	1,404,250	338,450	2,812,250	1,175,300	207,450	1,011,250	418,250	2,342,850	1,060,500	41,200	732,200	508,950

timber products harvested in the United States, by major product, region, and State, 1972, 1967, and 1963—Continued

(Thousand cubic feet)

			1967					1963				
eer s	Pulpwood	Other products[1]	Total	Saw logs	Veneer logs	Pulpwood	Other products[1]	Total	Saw logs	Veneer logs	Pulpwood	Other products[1]
100	12,650	6,550	274,400	214,350	33,200	18,700	8,150	201,900	168,050	24,200	3,950	5,700
400	14,100	10,350	310,650	231,900	46,750	21,150	10,850	255,200	238,150	4,200	5,600	7,250
550	700	1,400	33,650	25,150	5,950	1,200	1,350	19,250	18,150	[2]	350	750
[2]	100	7,100	34,750	31,900	[2]	150	2,700	39,600	34,900	[2]	250	4,450
[2]	1,350	10,250	41,050	29,050	[2]	1,800	10,200	42,350	32,300	[2]	[2]	10,050
[2]	5,100	17,800	95,150	70,050	[2]	7,500	17,600	66,250	51,050	[2]	7,250	7,950
[2]	[2]	1,300	10,950	9,600	[2]	[2]	1,350	13,500	12,350	[2]	[2]	1,150
[2]	250	650	5,550	4,200	[2]	350	1,000	5,900	5,500	[2]	[2]	400
050	34,250	55,400	806,150	616,200	85,900	50,850	53,200	643,950	560,450	28,400	17,400	37,700
900	153,100	63,650	1,123,750	752,700	112,500	195,950	62,600	975,600	591,150	102,400	228,200	53,850
200	98,500	37,200	1,624,450	971,150	479,500	133,850	39,950	1,855,550	1,198,600	540,000	71,850	45,100
000	37,000	20,200	716,750	582,100	72,850	48,000	13,800	825,700	722,550	88,200	4,050	10,900
[2]	25,500	[2]	58,850	23,350	[2]	35,500	[2]	70,500	11,350	[2]	59,150	[2]
150	[2]	200	900	[2]	[2]	[2]	900	500	250	[2]	[2]	250
250	314,100	121,250	3,524,700	2,329,300	664,850	413,300	117,250	3,727,850	2,523,900	730,600	363,250	110,100
300	348,350	176,650	4,330,850	2,945,500	750,750	464,150	170,450	4,371,800	3,084,350	759,000	380,650	147,800
700	3,644,250	950,000	11,102,450	5,427,800	1,078,000	3,306,650	1,290,000	10,573,700	5,414,550	912,100	2,677,050	1,570,000

mine timbers, cooperage logs, and logs and bolts used for shingles, excelsior, and a wide assortment of other wood items.

partment of Commerce, Bureau of the Census in the 1963, 1967, and 1972 *Censuses of Manufactures,* annual issues of Bureau of the Census Current
cted by the Forest Service as a part of surveys of timber products output by State.

1972			1967					1963				
Veneer logs	Pulpwood	Other products[2]	Total	Saw logs	Veneer logs	Pulpwood	Other products[2]	Total	Saw logs	Veneer logs	Pulpwood	Other products[2]
4,250	56,250	3,450	86,300	19,250	2,850	58,150	6,050	59,300	13,300	3,350	36,800	5,850
[3]	4,100	1,050	10,900	4,950	[3]	4,200	1,300	11,750	6,450	[3]	3,000	1,850
800	2,900	2,950	11,000	5,200	800	2,350	2,650	14,450	8,100	800	2,400	3,150
[3]	[3]	550	9,050	3,700	[3]	[3]	4,750	7,300	3,400	[3]	[3]	3,400
[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	800	[3]	[3]	[3]	[3]
[3]	[3]	,250	3,700	900	[3]	[3]	2,600	5,300	1,000	[3]	[3]	4,100
1,400	8,400	8,200	39,750	16,650	1,650	6,950	14,500	46,450	15,800	1,350	6,450	22,850
[3]	550	1,900	14,000	3,850	[3]	850	9,200	10,650	1,400	[3]	1,000	8,150
1,350	13,050	12,600	49,500	18,400	950	12,700	17,450	60,600	25,100	1,350	8,750	25,400
8,200	85,850	32,150	224,650	73,050	6,950	85,950	58,700	216,600	74,800	7,450	59,150	75,200
1,650	4,250	10,650	30,350	18,300	800	4,700	6,550	24,150	14,700	850	2,750	5,850
2,500	1,400	5,150	22,100	11,200	1,800	1,200	7,900	17,150	7,300	2,200	1,150	6,500
900	950	3,150	20,100	8,300	750	1,100	9,950	12,650	7,200	800	1,350	3,300
1,900	26,500	19,750	63,600	17,650	1,750	25,600	18,600	61,600	17,100	1,400	21,250	21,850
2,750	26,400	22,500	57,950	14,850	2,300	22,350	18,450	60,300	11,250	2,550	18,700	27,800
[3]	27,700	13,850	50,300	8,500	[3]	24,800	16,650	59,200	14,150	550	18,750	25,750
1,250	500	2,900	6,100	2,100	650	500	2,850	6,150	1,800	700	[3]	3,350
750	900	12,100	26,600	14,150	600	[3]	11,500	26,600	10,450	600	[3]	15,250
[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]
[3]	950	750	3,700	1,450	[3]	950	1,300	1,350	[3]	[3]	600	750
[3]	[3]	[3]	2,700	1,400	[3]	[3]	1,200	2,350	750	[3]	[3]	1,550
550	800	1,300	2,350	950	[3]	[3]	1,100	1,950	[3]	500	[3]	1,200
13,050	90,450	92,850	286,200	98,900	9,400	81,550	96,350	273,800	84,950	10,200	65,150	113,500
21,250	176,300	125,000	510,850	171,950	16,350	167,500	155,050	490,400	159,750	17,650	124,300	188,700
1,050	1,100	[3]	4,100	500	550	1,900	1,150	2,900	1,000	[3]	[3]	
3,850	4,300	1,450	14,950	6,150	2,050	4,550	2,200	17,000	9,050	1,600	3,050	3,300
15,800	34,750	8,750	79,700	33,750	5,950	33,400	6,600	93,600	46,900	2,900	27,050	16,750
650	2,850	4,750	32,200	17,150	600	4,500	9,950	34,000	16,000	500	4,100	13,400
27,800	63,850	12,700	122,500	48,000	10,750	43,650	20,100	104,700	45,550	8,200	29,200	21,750
23,200	54,500	9,850	110,500	47,350	6,200	42,650	14,300	67,750	19,550	5,400	31,700	11,100
22,350	134,200	17,000	185,050	55,200	7,750	102,800	19,300	156,850	45,900	6,550	77,450	26,950
13,050	66,400	2,650	71,000	9,450	5,550	50,300	5,700	56,800	6,650	4,950	37,750	7,450
107,750	361,950	57,600	620,000	217,550	39,400	283,750	79,300	533,600	190,600	30,450	210,750	101,800
750	2,750	8,300	28,250	18,800	650	1,200	7,600	34,950	22,050	750	850	11,300
1,100	9,350	8,300	39,450	23,650	600	5,700	9,500	38,350	19,800	750	5,700	12,100
37,700	115,800	22,450	174,050	57,550	10,850	83,200	22,450	107,750	40,950	3,200	44,050	19,550
33,350	72,650	19,450	116,600	47,050	9,250	39,400	20,900	80,200	33,450	1,950	24,350	20,450
32,850	44,300	19,700	119,800	62,400	11,050	24,900	21,450	97,100	52,150	950	19,700	24,300
60,600	60,600	14,550	137,750	68,350	22,350	32,950	14,100	87,250	43,150	1,950	27,100	15,050
3,600	5,950	1,700	8,750	4,000	[3]	1,000	3,550	11,850	4,700	[3]	[3]	6,750
43,550	45,800	5,750	78,300	35,950	8,800	24,050	9,500	66,550	36,250	1,600	15,200	13,500

(Thousand dollars)

72			1967					1963				
Veneer logs	Pulpwood	Other products[2]	Total	Saw logs	Veneer logs	Pulpwood	Other products[2]	Total	Saw logs	Veneer logs	Pulpwood	Other products[2]
1,050	1,100	[3]	4,100	500	550	1,900	1,150	2,900	1,000	[3]	1,100	
3,850	4,300	1,450	14,950	6,150	2,050	4,550	2,200	17,000	9,050	1,600	3,050	3,300
15,800	34,750	8,750	79,700	33,750	5,950	33,400	6,600	93,600	46,900	2,900	27,050	16,750
650	2,850	4,750	32,200	17,150	600	4,500	9,950	34,000	16,000	500	4,100	13,400
27,800	63,850	12,700	122,500	48,000	10,750	43,650	20,100	104,700	45,550	8,200	29,200	21,750
23,200	54,500	9,850	110,500	47,350	6,200	42,650	14,300	67,750	19,550	5,400	31,700	11,100
22,350	134,200	17,000	185,050	55,200	7,750	102,800	19,300	156,850	45,900	6,550	77,450	26,950
13,050	66,400	2,650	71,000	9,450	5,550	50,300	5,700	56,800	6,650	4,950	37,750	7,450
07,750	361,950	57,600	620,000	217,550	39,400	283,750	79,300	533,600	190,600	30,450	210,750	101,800
750	2,750	8,300	28,250	18,800	650	1,200	7,600	34,950	22,050	750	850	11,300
1,100	9,350	8,300	39,450	23,650	600	5,700	9,500	38,350	19,800	750	5,700	12,100
37,700	115,800	22,450	174,050	57,550	10,850	83,200	22,450	107,750	40,950	3,200	44,050	19,550
33,350	72,650	19,450	116,600	47,050	9,250	39,400	20,900	80,200	33,450	1,950	24,350	20,450
32,850	44,300	19,700	119,800	62,400	11,050	24,900	21,450	97,100	52,150	950	19,700	24,300
50,600	60,600	14,550	137,750	68,350	22,350	32,950	14,100	87,250	43,150	1,950	27,100	15,050
3,600	5,950	1,700	8,750	4,000	[3]	1,000	3,550	11,850	4,700	[3]	[3]	6,750
43,550	45,800	5,750	78,300	35,950	8,800	24,050	9,500	66,550	36,250	1,600	15,200	13,500
13,500	357,200	702,950		317,750	63,750	212,400	109,050	524,000	252,500	11,200	137,300	123,9000
21,250	719,150	157,800	1,322,950	535,300	103,150	496,150	188,350	1,057,600	443,100	41,650	348,050	224,800
29,750	2,700	2,000	94,650	74,400	14,800	2,850	2,600	65,900	53,950	9,300	550	2,100
35,500	3,050	2,900	111,650	79,650	25,800	3,250	2,950	86,050	80,950	2,250	800	2,050
4,250	[3]	[3]	9,600	6,850	2,300	[3]	[3]	4,950	4,800	[3]	[3]	[3]
[3]	[3]	1,600	9,700	9,100	[3]	[3]	550	10,650	9,900	[3]	[3]	700
[3]	[3]	2,200	12,900	10,700	[3]	[3]	1,900	13,850	12,250	[3]	[3]	1,600
[3]	950	3,850	28,400	24,300	[3]	1,000	3,100	19,650	17,600	[3]	900	1,150
[3]	[3]	[3]	3,150	2,900	[3]	[3]	[3]	3,850	3,600	[3]	[3]	[3]
[3]	[3]	[3]	1,650	1,400	[3]	[3]	[3]	2,150	2,000	[3]	[3]	[3]
59,500	7,250	13,200	271,700	209,300	42,900	7,700	11,800	207,050	185,050	11,550	2,350	8,100
79,750	45,150	28,750	424,700	285,400	70,550	39,900	28,850	341,700	213,400	57,850	41,600	28,850
26,700	29,700	15,000	716,900	371,650	303,000	28,850	13,400	804,550	455,450	321,300	14,450	13,350
34,050	11,100	7,750	278,450	217,600	45,100	10,300	5,450	306,750	252,900	48,500	800	4,550
[3]	5,000	[3]	13,750	8,800	[3]	4,950	[3]	11,600	3,850	[3]	7,750	[3]
[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]
90,700	90,950	51,550	1,434,000	883,450	418,650	84,000	47,900	1,464,750	925,700	427,650	64,600	46,800
50,200	98,200	64,750	1,705,700	1,092,750	461,550	91,700	59,700	1,671,800	1,110,750	439,200	66,950	54,900
02,700	993,650	347,550	3,539,500	1,800. 00	581,050	755,350	403,100	3,219,800	1,713,600	498,500	539,300	468,400

Table A-5. Estimated value of timber products harvested, value added, and value added attributed to timber in the United States, by region and State, 1972, 1967, and 1963

(Thousand dollars)

Region and State	1972			1967			
	Value	Value added	Value added attributed to timber	Value	Value added	Value added attributed to timber	Value
North:							
Northeast:							
Maine	99,400	44,400	44,400	86,300	40,900	40,900	59,300
New Hampshire	19,300	6,700	6,700	10,900	4,450	4,450	11,750
Vermont	15,450	6,550	6,550	11,000	6,050	6,050	14,450
Massachusetts	6,900	2,950	2,950	9,250	4,250	4,250	7,300
Rhode Island	650	[2]	[2]	[2]	[2]	[2]	800
Connecticut	3,250	1,350	1,350	3,700	1,700	1,700	5,300
New York	39,200	20,450	20,450	39,750	21,150	21,150	46,450
New Jersey	4,550	3,150	3,150	14,000	7,600	7,600	10,650
Pennsylvania	59,500	32,200	32,200	49,500	27,200	27,200	60,600
Total	248,200	118,000	118,000	224,650	113,550	113,550	216,600
North Central:							
Ohio	40,250	18,200	18,200	30,350	15,400	15,400	24,150
Indiana	24,750	12,250	12,250	22,100	11,350	11,350	17,150
Illinois	17,800	8,850	8,850	20,100	8,800	8,800	12,650
Michigan	81,850	42,800	42,800	63,600	37,750	35,750	61,600
Wisconsin	76,350	37,100	37,100	57,950	27,800	27,800	60,300
Minnesota	52,900	25,700	25,700	50,300	24,150	24,150	59,200
Iowa	9,500	4,850	4,850	6,100	2,850	2,850	6,150
Missouri	33,800	17,100	17,100	26,600	12,450	12,450	26,600
North Dakota	[2]	[2]	[2]	[2]	[2]	[2]	
South Dakota	4,250	2,200	2,200	3,700	1,750	1,750	1,350
Nebraska	2,900	1,500	1,500	2,700	1,300	1,300	2,350
Kansas	4,000	2,050	2,050	2,350	1,100	1,100	1,950
Total	348,800	172,850	172,850	286,200	142,850	142,850	273,800
Total, North	597,000	290,850	290,850	510,850	256,400	256,400	490,400
South:							
Southeast:							
Delaware	3,900	1,950	1,950	4,100	2,600	2,600	2,900
Maryland	24,450	11,950	11,950	14,950	9,450	9,450	17,000
Virginia	116,900	58,800	58,800	79,700	42,900	42,900	93,600
West Virginia	36,100	17,050	17,050	32,200	18,200	18,200	34,000
North Carolina	199,400	91,500	91,500	122,500	69,250	69,250	104,700
South Carolina	159,200	86,600	86,600	110,500	58,650	58,650	67,750
Georgia	304,950	145,450	145,450	185,050	92,900	92,900	156,850
Florida	104,450	48,500	48,500	71,000	37,250	37,250	56,800
Total	949,350	461,800	461,800	620,000	331,200	331,200	533,600
South Central:							
Kentucky	41,850	20,400	20,400	28,250	14,700	14,700	34,950
Tennessee	54,500	26,450	26,450	39,450	18,850	18,850	38,350
Alabama	298,750	164,950	164,950	174,050	91,400	91,400	107,750
Mississippi	225,700	107,700	107,700	116,600	53,050	53,050	80,200
Arkansas	216,850	98,000	98,000	119,800	57,300	57,300	97,100
Louisiana	262,200	145,300	145,300	137,750	62,950	62,950	87,250
Oklahoma	25,150	11,500	11,500	8,750	4,100	4,100	11,850
Texas	178,300	64,900	64,900	78,300	39,400	39,400	66,550
Total	1,303,300	639,200	639,200	703,950	341,750	341,750	524,90
Total, South	2,252,650	1,101,000	1,101,000	1,322,950	672,950	672,950	1,057,600
West:							
Mountain:							
Montana	171,700	94,950	94,950	94,650	50,850	50,850	65,90
Idaho	184,900	76,900	76,900	111,650	53,300	53,300	86,05
Wyoming	21,200	11,500	11,500	9,600	5,400	5,400	4,95
Colorado	16,300	8,200	8,200	9,700	5,500	5,500	13,85
New Mexico	23,950	15,950	15,950	12,900	9,150	9,150	13,95
Arizona	41,400	28,750	28,750	28,400	19,750	19,750	19,65

Table A-6—Estimated employment in timber harvesting in the United States, by major product and regi

(Number)

Region	Total employees	Product	
		Saw logs	Veneer logs
		1972	
North:			
Northeast	19,350	7,750	[2]
North Central	25,900	8,800	[2]
Total	45,250	16,550	900
South:			
Southeast	40,300	11,400	2,500
South Central	57,200	18,900	7,150
Total	97,500	30,300	9,650
West:			
Mountain	8,350	5,900	1,000
Pacific	39,300	24,200	8,900
Total	47,650	30,100	9,900
Total, United States	190,400	76,950	20,450
		1967	
North:			
Northeast	28,700	8,850	650
North Central	34,200	10,900	650
Total	62,900	19,750	1,300
South:			
Southeast	54,300	14,350	2,250
South Central	63,800	23,500	5,150
Total	118,100	37,850	7,400
West:			
Mountain	10,200	6,950	1,250
Pacific	45,150	26,300	9,600
Total	55,350	33,250	10,850
Total, United States	236,350	90,850	19,550
		1963	
North:			
Northeast	32,700	9,600	850
North Central	40,800	11,350	750
Total	73,500	20,950	1,600
South:			
Southeast	69,350	17,850	2,450
South Central	67,650	26,250	1,250
Total	137,000	44,100	3,700
West:			
Mountain	9,400	7,550	500
Pacific	56,650	34,100	12,650
Total	66,050	41,650	13,150

Table A-7—Estimated employment in timber harvesting in the United States, by region and State, 1972, 1

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	8,600	10,900	8,850
New Hampshire	1,450	1,450	1,700
Vermont	1,300	1,400	2,000
Massachusetts	[1]	1,300	1,200
Rhode Island	[1]	[1]	[1]
Connecticut	[1]	500	1,000
New York	2,900	5,050	7,200
New Jersey	[1]	1,950	1,650
Pennsylvania	4,100	6,100	8,900
Total	19,350	28,700	32,700
North Central:			
Ohio	2,700	3,700	3,700
Indiana	1,400	2,200	2,150
Illinois	1,200	3,500	1,900
Michigan	5,900	6,900	8,850
Wisconsin	5,650	6,200	8,550
Minnesota	4,100	5,200	7,900
Iowa	800	850	1,100
Missouri	3,150	4,100	5,400
North Dakota	[1]	[1]	[1]
South Dakota	[1]	700	[1]
Nebraska	[1]	[1]	[1]
Kansas	[1]	[1]	[1]
Total	25,900	34,200	40,800
Total, North	45,250	62,900	73,500
South:			
Southeast:			
Delaware	[1]	[1]	[1]
Maryland	800	1,050	1,800
Virginia	4,800	6,400	11,150
West Virginia	1,600	3,000	4,400
North Carolina	7,700	9,850	12,000
South Carolina	6,350	8,950	8,050
Georgia	14,150	18,600	24,350
Florida	4,750	6,200	7,400
Total	40,300	54,300	69,350

Region and State	1972	1967
South Central:		
Kentucky	2,050	2,60
Tennessee	2,700	3,75
Alabama	13,650	16,15
Mississippi	10,550	11,20
Arkansas	9,200	10,55
Louisiana	10,850	11,70
Oklahoma	1,100	90
Texas	7,100	6,95
Total	57,200	63,80
Total, South	97,500	118,11
West:		
Mountain:		
Montana	2,750	3,40
Idaho	3,150	3,90
Wyoming	[1]	
Colorado	[1]	
New Mexico	550	60
Arizona	950	1,30
Utah	[1]	
Nevada	[1]	
Total	8,350	10,20
Pacific:		
Washington	12,950	14,65
Oregon	17,200	20,95
California	8,350	8,70
Alaska	800	85
Hawaii	[1]	
Total	39,300	45,15
Total, West	47,650	55,35
Total, United States	190,400	236,35

[1] Less than 500 employees.

Sources: See table A-6.

Table A-8—Estimated production of lumber in the United States, by major species groups

(Million board feet)

Region and species group	1963	1964	1965	1966	1967	1968	1969
North:							
Northeast:							
Softwoods	623	673	644	655	629	645	644
Hardwoods	856	862	884	925	907	928	1,035
Total	1,479	1,535	1,528	1,580	1,536	1,573	1,679
North Central:							
Softwoods	470	369	368	383	371	423	392
Hardwoods	1,256	1,426	1,432	1,458	1,471	1,449	1,528
Total	1,726	1,795	1,800	1,841	1,842	1,872	1,920
Total North:							
Softwoods	1,093	1,042	1,012	1,038	1,000	1,068	1,036
Hardwoods	2,112	2,288	2,316	2,383	2,378	2,377	2,563
Total	3,205	3,330	3,328	3,421	3,378	3,445	3,599
South:							
Southeast:							
Softwoods	2,907	3,075	3,109	3,117	3,012	3,116	3,092
Hardwoods	2,334	2,072	2,141	2,258	2,192	2,132	2,114
Total	5,241	5,147	5,250	5,375	5,204	5,248	5,206
South Central:							
Softwoods	3,466	3,641	3,795	3,742	3,743	4,025	4,352
Hardwoods	2,529	2,754	2,849	2,892	2,663	2,523	2,648
Total	5,995	6,395	6,644	6,634	6,406	6,548	7,000
Total South:							
Softwoods	6,373	6,716	6,904	6,859	6,755	7,141	7,444
Hardwoods	4,863	4,826	4,990	5,150	4,855	4,655	4,762
Total	11,236	11,542	11,894	12,009	11,610	11,796	12,206
West:							
Mountain:							
Softwoods	3,702	4,038	4,116	4,149	4,154	4,528	4,361
Hardwoods	39	9	9	18	17	17	16
Total	3,741	4,047	4,125	4,167	4,171	4,545	4,377
Pacific:							
Softwoods	16,384	17,488	17,263	16,801	15,402	16,548	15,501
Hardwoods	140	152	152	186	180	139	141
Total	16,524	17,640	17,415	16,987	15,582	16,687	15,642
Total West:							
Softwoods	20,086	21,526	21,379	20,950	19,556	21,076	19,862
Hardwoods	179	161	161	204	197	156	157
Total	20,265	21,687	21,540	21,154	19,753	21,232	20,019
United States:							
Softwoods	27,552	29,284	29,295	28,847	27,311	29,285	28,342
Hardwoods	7,154	7,275	7,467	7,737	7,430	7,188	7,482

Table A-9—Estimated production of plywood in the United States, by major species groups and r

(Million square feet, 3/8-inch basis)

Region and species group	1963	1964	1965	1966	1967	1968	1969
North:							
Northeast:							
Softwoods	—	—	—	—	—	—	—
Hardwoods	177	194	211	208	172	166	162
Total	177	194	211	208	172	166	162
North Central:							
Softwoods	—	—	—	—	—	—	—
Hardwoods	274	310	306	325	284	281	290
Total	274	310	306	325	284	281	290
Total, North:							
Softwoods	—	—	—	—	—	—	—
Hardwoods	451	504	517	533	456	447	452
Total	451	504	517	533	456	447	452
South:							
Southeast:							
Softwoods	—	—	22	181	343	555	687
Hardwoods	555	572	603	654	616	596	594
Total	555	572	625	835	959	1,151	1,281
South Central:							
Softwoods	—	80	380	959	1,436	1,818	2,188
Hardwoods	201	212	257	281	230	208	178
Total	201	292	637	1,240	1,666	2,026	2,366
Total, South:							
Softwoods	—	80	402	1,140	1,779	2,373	2,875
Hardwoods	756	784	860	935	846	804	772
Total	756	864	1,262	2,075	2,625	3,177	3,647
West:							
Mountain:							
Softwoods	358	495	730	892	1,062	1,065	918
Hardwoods	—	—	—	—	—	—	—
Total	358	495	730	892	1,062	1,065	918
Pacific:							
Softwoods	9,858	11,103	11,315	11,022	10,116	11,257	9,901
Hardwoods	476	624	672	608	614	758	645
Total	10,334	11,727	11,987	11,630	10,730	12,015	10,546
Total, West:							
Softwoods	10,216	11,598	12,045	11,914	11,178	12,322	10,819
Hardwoods	476	624	672	608	614	758	645
Total	10,692	12,222	12,717	12,522	11,792	13,080	11,464
United States:							
Softwoods	10,216	11,679	12,447	13,045	13,054	14,695	13,694
Hardwoods	1,683	1,912	2,049	2,076	1,916	2,009	1,869
Total	11,899	13,591	14,496	15,130	14,873	16,704	15,563

Table A-10—Estimated production of wood pulp in the United States, by regio

(Thousand short tons)

Region	1963	1964	1965	1966	1967	1968	1969
North:							
Northeast	3,143	3,201	3,232	3,408	3,769	3,975	4,036
North Central	3,223	3,331	3,438	3,517	3,407	3,606	3,946
Total, North	6,366	6,532	6,670	6,925	7,176	7,581	7,982
South:							
Southeast	10,647	11,473	12,183	12,995	12,828	13,808	14,388
South Central	7,241	8,238	8,473	9,381	9,294	9,990	13,043
Total, South	17,888	19,711	20,656	22,376	22,122	23,798	27,430
West:							
Mountain	569	585	621	678	751	799	804
Pacific	5,298	5,601	6,046	6,660	6,612	7,221	7,201
Total, West	5,868	6,186	6,667	7,339	7,362	8,020	8,004
Total, United States	310,121	32,429	33,993	36,640	36,660	39,400	43,416

Note: Data may not add to totals due to rounding.

Source: U.S. Department of Commerce, Bureau of the Census, *Pulp, paper, and board.* Curr. Indus. Reps. Ser. M26A, (annual).

Table A-11—Estimated value of shipments from primary manufacturing industries in the Unit
by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total	Sawmills and planing mills	Veneer and plywood plants	Pulp and boar
			1972	
North:				
Northeast	3,016,850	383,900	73,800	2,5
North Central	2,157,050	446,200	170,200	2,4
Total	6,173,900	830,100	244,000	5,0
South:				
Southeast	4,470,600	1,262,000	462,100	2,5
South Central	4,909,500	1,693,800	499,400	2,5
Total	9,380,100	2,955,800	961,500	5,0
West:				
Mountain	800,200	641,900	110,000	
Pacific	6,663,700	3,146,900	1,607,800	1,6
Total	7,463,900	3,788,800	1,717,800	1,6
Total, United States	23,107,900	7,574,700	2,923,300	11,7
			1967	
North:				
Northeast	2,491,600	264,600	57,700	2,1
North Central	2,427,300	257,200	146,700	1,9
Total	4,918,900	521,800	204,400	4,1
South:				
Southeast	2,984,250	725,050	225,000	1,9
South Central	2,790,750	979,650	177,000	1,5
Total	5,775,000	1,704,700	402,000	3,4
West:				
Mountain	515,450	387,700	54,700	
Pacific	3,811,350	1,562,900	1,026,100	1,1
Total	4,326,800	1,950,600	1,080,800	1,2
Total, United States	15,020,700	4,177,100	1,687,200	8,8
			1963	
North:				
Northeast	2,107,950	211,600	49,500	1,8
North Central	1,974,700	221,550	143,250	1,5

Table A-12—Estimated value of shipments from primary manufacturing industries in th by region and State, 1972, 1967, and 1963

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	762,000	588,750	433,500
New Hampshire	166,550	144,500	119,100
Vermont	87,800	56,850	50,900
Massachusetts	317,450	317,400	281,500
Rhode Island	12,150	6,050	4,750
Connecticut	107,200	89,300	74,700
New York	630,950	533,850	474,950
New Jersey	258,500	242,650	223,750
Pennsylvania	674,250	512,250	444,800
Total	3,016,850	2,491,600	2,107,950
North Central:			
Ohio	625,200	488,550	393,650
Indiana	193,100	163,400	142,900
Illinois	192,550	165,000	123,300
Michigan	592,550	459,000	377,800
Wisconsin	1,056,650	811,050	653,550
Minnesota	322,300	222,550	181,200
Iowa	35,200	26,250	22,550
Missouri	91,950	66,800	60,550
North Dakota	3,500	750	850
South Dakota	12,800	6,050	4,100
Nebraska	2,150	2,200	1,000
Kansas	29,100	15,700	13,250
Total	3,157,050	2,427,300	1,974,700
Total, North	6,173,900	4,918,900	4,082,650
South:			
Southeast:			
Delaware	27,400	17,450	12,900
Maryland	202,600	125,650	89,050
Virginia	793,550	542,150	428,900
West Virginia	115,650	95,650	78,200
North Carolina	944,050	647,950	474,700
South Carolina	584,350	365,300	303,400
Georgia	1,172,100	737,700	615,400
Florida	630,900	452,400	398,950
Total	4,470,600	2,984,250	2,401,500

Region and State	1972
South Central:	
Kentucky	221,850
Tennessee	544,850
Alabama	902,450
Mississippi	737,550
Arkansas	771,850
Louisiana	956,850
Oklahoma	145,250
Texas	628,850
Total	4,909,500
Total, South	9,380,100
West:	
Mountain:	
Montana	226,900
Idaho	387,100
Wyoming	19,600
Colorado	37,800
New Mexico	49,450
Arizona	56,000
Utah	18,400
Nevada	4,950
Total	800,200
Pacific:	
Washington	1,979,050
Oregon	2,954,600
California	1,636,900
Alaska	92,000
Hawaii	1,150
Total	6,663,700
Total, West	7,463,900
Total, United States	23,017,900

Note: Industry composition and definitions are given in Appendix B.

Sources: See table A-11.

Footnote for Table A-11.

[1] Includes enterprises manufacturing particleboard, excelsior, wood shingles, cooperage, and gum and wood naval stores.

Note: Industry composition and definitions are given in Appendix B.

Sources: *Value of shipments:* U.S. Department of Commerce, Bureau of the Census. 1963, 1967, and 1972 *Censuses of Manufactures*. The sawmill

Table A-13—Estimated value added in primary manufacturing industries in the United States, by industry and regio

(Thousand dollars)

Region	Total	Sawmills and planing mills	Veneer and plywood plants	Pulp, p and pa board
			1972	
North:				
Northeast	1,294,500	130,800	29,800	1,128
North Central	1,384,600	157,450	72,050	1,114
Total	2,679,100	288,250	101,850	2,243
South:				
Southeast	1,946,150	479,500	187,400	1,163
South Central	2,183,450	675,650	217,100	1,195
Total	4,129,600	1,155,150	404,500	2,359
West:				
Mountain	338,950	279,650	34,250	16
Pacific	2,921,200	1,306,300	697,800	798
Total	3,260,150	1,585,950	732,050	814
Total, United States	10,068,850	3,029,350	1,238,400	5,417
			1967	
North:				
Northeast	1,131,550	93,050	22,850	1,009
North Central	1,140,150	93,800	64,600	965
Total	2,271,700	186,850	87,250	1,974
South:				
Southeast	1,408,000	277,150	89,150	985
South Central	1,281,250	371,850	71,850	789
Total	2,689,250	649,000	161,000	1,775
West:				
Mountain	198,100	144,900	18,850	33
Pacific	1,507,400	544,850	381,600	557
Total	1,705,500	689,750	400,450	590
Total, United States	6,666,450	1,525,600	648,700	4,340
			1963	
North:				
Northeast	929,100	66,100	20,600	837
North Central	909,650	78,500	59,050	758
Total	1,838,750	144,600	79,650	1,597

Table A-14—Estimated value added in primary manufacturing industries in the United States, by re

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	318,500	262,550	212,650
New Hampshire	62,650	58,700	38,200
Vermont	35,500	22,450	16,950
Massachusetts	150,050	152,700	136,150
Rhode Island	5,450	2,950	2,400
Connecticut	50,550	42,500	33,900
New York	268,200	232,850	194,150
New Jersey	121,450	123,300	106,700
Pennsylvania	282,150	233,550	188,000
Total	1,294,500	1,131,550	929,100
North Central:			
Ohio	272,900	252,650	194,250
Indiana	87,500	72,700	62,700
Illinois	84,200	79,550	55,350
Michigan	255,600	198,200	161,700
Wisconsin	465,400	382,500	307,650
Minnesota	149,200	105,450	86,700
Iowa	16,650	12,550	10,400
Missouri	33,250	25,500	22,100
North Dakota	1,300	[1]	[1]
South Dakota	6,500	2,750	1,750
Nebraska	950	850	450
Kansas	11,150	7,150	6,250
Total	1,384,600	1,140,150	909,650
Total, North	2,679,100	2,271,700	1,838,750
South:			
Southeast:			
Delaware	11,950	7,450	5,050
Maryland	90,300	61,900	43,400
Virginia	358,300	267,400	201,350
West Virginia	50,250	43,450	32,750
North Carolina	390,750	292,900	219,000
South Carolina	249,700	167,500	137,400
Georgia	527,250	352,750	307,600
Florida	267,650	214,650	191,000
Total	1,946,150	1,408,000	1,137,550

Region and State	197
South Central:	
Kentucky	95,
Tennessee	226,
Alabama	415,
Mississippi	323,
Arkansas	346,
Louisiana	435,
Oklahoma	65,
Texas	275,
Total	2,183,
Total, South	4,129,
West:	
Mountain:	
Montana	97,
Idaho	157,
Wyoming	8,
Colorado	16,
New Mexico	22,
Arizona	25,
Utah	8,
Nevada	2,
Total	338,
Pacific:	
Washington	878,
Oregon	1,282,
California	718,
Alaska	41,
Hawaii	
Total	2,921,
Total, West	3,260,
Total, United States	10,068,

[1] Less than 500 thousand dollars.

Note: Industry composition and definition are given in Appendix B.

Sources: See table A-13.

Footnotes for Table A-13.

[1] Includes enterprises manufacturing particleboard, excelsior, wood shingles, cooperage, and gum and wood naval stores.

Note: Industry composition and definitions are given in Appendix B.

Sources: *Value added:* U.S. Department of Commerce, Bureau of Census, 1963, 1967, and 1972 *Censuses of Manufactures.* The sawmills an clude the value added in small eastern mills not covered by Census estimates, and to exclude the value added in logging and woods operations plywood and pulp, paper, and paperboard industries values added were also adjusted to exclude the value reported by Census and the com Estimates of values added for States and regions for which no Census information was published were derived from table footnotes and ind

Region	1972		1967	
	Census	This study	Census	This study
	Thousand dollars	Thousand dollars	Thousand dollars	Thousand dollars

Table A-15—Estimated value added attributed to timber in primary manufacturing industries in the by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total	Sawmills and planing mills	Veneer and plywood plants	Pulp, and pa board
			1972	
North:				
Northeast	1,108,650	124,300	26,850	952
North Central	1,176,950	149,600	64,800	936
Total	2,285,600	273,900	91,650	1,888
South:				
Southeast	1,693,100	455,550	163,050	984
South Central	1,910,300	641,850	188,900	1,013
Total	3,603,400	1,097,400	351,950	1,997
West:				
Mountain	313,350	265,600	29,450	14
Pacific	2,594,600	1,239,400	600,100	682
Total	2,907,950	1,505,000	629,550	696
Total, United States	8,796,950	2,876,300	1,073,150	4,583
			1967	
North:				
Northeast	942,650	88,400	20,550	828
North Central	937,650	89,100	57,950	774
Total	1,880,300	177,500	78,500	1,603
South:				
Southeast	1,148,850	263,300	80,200	752
South Central	1,082,100	353,250	64,700	619
Total	2,230,950	616,550	144,900	1,371
West:				
Mountain	181,000	137,650	17,000	25
Pacific	1,336,450	517,450	343,450	454
Total	1,517,450	655,100	360,450	479
Total, United States	5,628,700	1,449,150	583,850	3,454
			1963	
North:				
Northeast	793,400	62,800	18,550	707
North Central	780,100	74,600	53,150	639
Total	1,573,500	137,400	71,700	1,346

Table A-16—Estimated value added attributed to timber in primary manufacturing industries by region and State, 1972, 1967, and 1963

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	273,000	225,150	181,900
New Hampshire	54,400	50,600	33,500
Vermont	31,300	19,200	15,200
Massachusetts	128,300	127,500	116,150
Rhode Island	4,050	2,150	1,750
Connecticut	43,200	33,050	28,900
New York	230,200	195,700	166,250
New Jersey	100,750	95,050	88,550
Pennsylvania	243,450	194,250	161,200
Total	1,108,650	942,650	793,400
North Central:			
Ohio	233,650	206,200	165,600
Indiana	75,600	61,000	55,500
Illinois	70,450	61,650	46,950
Michigan	214,800	159,300	139,250
Wisconsin	398,250	323,150	263,900
Minnesota	121,450	84,700	72,100
Iowa	13,800	9,400	8,650
Missouri	31,250	23,100	20,300
North Dakota	1,150	[1]	[1]
South Dakota	6,150	2,650	1,650
Nebraska	750	750	[1]
Kansas	9,650	5,500	5,450
Total	1,176,950	937,650	780,100
Total, North	2,285,600	1,880,300	1,573,500
South:			
Southeast:			
Delaware	10,350	6,050	4,450
Maryland	77,250	51,750	37,400
Virginia	304,900	215,450	176,750
West Virginia	46,700	40,150	30,250
North Carolina	342,600	251,700	194,650
South Carolina	217,700	131,700	121,200
Georgia	457,250	278,000	269,950
Florida	236,350	174,050	166,850
Total	1,693,100	1,148,850	1,001,500

Region and State	1972
South Central:	
Kentucky	85,150
Tennessee	202,500
Alabama	363,250
Mississippi	282,450
Arkansas	307,350
Louisiana	373,800
Oklahoma	52,650
Texas	243,150
Total	1,910,300
Total, South	3,603,400
West:	
Mountain:	
Montana	89,350
Idaho	146,450
Wyoming	8,450
Colorado	15,300
New Mexico	20,650
Arizona	23,050
Utah	7,950
Nevada	2,150
Total	313,350
Pacific:	
Washington	786,050
Oregon	1,122,750
California	647,800
Alaska	37,500
Hawaii	500
Total	2,594,600
Total, West	2,907,950
Total, United States	8,796,950

[1] Less than 500 thousand dollars.

Note: Industry composition and definitions are given in Appendix B.

Sources: See table A-15.

Table A-17—Estimated employment in primary manufacturing industries in the United Sta by industry and region, 1972, 1967, and 1963

(Number)

Region	Total	Sawmills and planing mills	Veneer and plywood plants	Pulp, and p board
			1972	
North:				
Northeast	69,750	10,300	2,650	56
North Central	72,600	12,000	5,150	52
Total	142,350	22,300	7,800	109
South:				
Southeast	97,300	37,750	13,050	41
South Central	110,200	51,800	11,850	41
Total	207,500	89,550	24,900	82
West:				
Mountain	18,300	14,950	1,550	1
Pacific	119,750	56,700	32,150	24
Total	138,050	71,650	33,700	25
Total, United States	487,900	183,500	66,400	217
			1967	
North:				
Northeast	81,550	12,050	2,950	65
North Central	79,400	11,950	6,550	58
Total	160,950	24,000	9,500	124
South:				
Southeast	101,100	41,300	13,400	43
South Central	106,350	56,900	8,750	36
Total	207,450	98,200	22,150	79
West:				
Mountain	18,900	15,550	1,700	1,
Pacific	114,600	51,350	36,850	23
Total	133,500	66,900	38,550	25
Total, United States	501,900	189,100	70,200	229
			1963	
North:				
Northeast	81,950	12,100	2,650	66
North Central	74,900	13,350	7,000	52
Total	156,850	25,450	9,650	118
South:				
Southeast	106,400	50,100	12,350	40
South Central	107,850	65,100	4,700	33

Table A-18—Estimated employment in primary manufacturing industries in the United States, by regi

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	16,300	18,300	16,750
New Hampshire	4,250	4,400	4,400
Vermont	2,000	2,350	2,650
Massachusetts	7,950	11,300	12,050
Rhode Island	[1]	[1]	[1]
Connecticut	2,150	2,250	2,450
New York	14,800	17,400	18,600
New Jersey	6,050	7,350	7,650
Pennsylvania	15,950	17,950	17,200
Total	69,750	81,550	81,950
North Central:			
Ohio	13,600	15,250	12,850
Indiana	5,450	6,150	6,200
Illinois	4,900	6,200	5,250
Michigan	13,400	14,000	12,900
Wisconsin	23,150	24,950	24,800
Minnesota	7,650	7,600	7,500
Iowa	750	900	900
Missouri	2,650	3,450	3,600
North Dakota	[1]	[1]	[1]
South Dakota	[1]	[1]	[1]
Nebraska	[1]	[1]	[1]
Kansas	600	550	550
Total	72,600	79,400	74,900
Total, North	142,350	160,950	156,850
South:			
Southeast:			
Delaware	500	650	550
Maryland	3,900	4,050	3,900
Virginia	18,700	19,350	20,600
West Virginia	3,550	5,000	5,400
North Carolina	24,900	26,800	27,400
South Carolina	12,450	12,750	13,450
Georgia	22,000	20,700	22,300
Florida	11,300	11,800	12,800
Total	97,300	101,100	106,400

Region and State	1972
South Central:	
Kentucky	6,00
Tennessee	12,75
Alabama	21,00
Mississippi	16,75
Arkansas	18,15
Louisiana	18,95
Oklahoma	2,85
Texas	13,75
Total	110,20
Total, South	207,50
West:	
Mountain:	
Montana	5,35
Idaho	7,60
Wyoming	50
Colorado	1,30
New Mexico	1,25
Arizona	1,65
Utah	55
Nevada	
Total	18,30
Pacific:	
Washington	36,90
Oregon	52,70
California	28,75
Alaska	1,35
Hawaii	
Total	119,75
Total, West	138,05
Total, United States	487,90

[1] Less than 500 employees.

Note: Industry composition and definitions are given in Appendix B.

Sources: See table A-17.

Footnotes for Table A-17.

[1] Includes enterprises manufacturing particleboard, excelsior, wood shingles, cooperage, and gum and wood naval stores.

[2] Less than 500 employees.

Note: Industry composition and definitions are given in Appendix B.

Source: *Employment:* U.S. Department of Commerce, Bureau of the Census 1963, 1967, and 1972 *Censuses of Manufactures*. The sawmills and p
to include estimates of employment in logging and woods operations conducted in combination with those industries. The employment reported b
study are shown below. Estimates of employment for States and regions for which no Census information was published were derived from tab

Region	1972		1967	
	Census	This study	Census	This study
	(Number)	(Number)	(Number)	(Number)

Sawmills and planing mills

Table A-19—Estimated employment attributed to timber in primary manufacturing industries in the by industry and region, 1972, 1967, and 1963

(Number)

Region	Total	Sawmills and planing mills	Veneer and plywood plants	Pulp, and p board
1972				
North:				
Northeast	59,850	9,450	2,400	47,
North Central	61,800	10,950	4,600	44,
Total	121,650	20,400	7,000	92,
South:				
Southeast	85,150	35,100	11,400	35,
South Central	96,400	47,800	10,300	34,
Total	181,550	82,900	21,700	70,
West:				
Mountain	16,950	14,200	1,350	1.
Pacific	106,400	53,700	27,650	20.
Total	123,350	67,900	29,000	21.
Total, United States	426,550	171,200	57,700	183.
1967				
North:				
Northeast	68,700	11,300	2,650	54.
North Central	66,550	11,150	5,950	47.
Total	135,250	22,450	8,600	101,
South:				
Southeast	87,100	38,900	12,050	33,
South Central	94,050	53,350	7,850	29,
Total	181,150	92,250	19,900	62,
West:				
Mountain	17,600	14,750	1,500	1,
Pacific	103,750	48,800	33,200	19,
Total	121,350	63,550	34,700	20,
Total, United States	437,750	178,250	63,200	184,
1963				
North:				
Northeast	70,550	11,350	2,350	56.
North Central	64,850	12,450	6,300	44.
Total	135,400	23,800	8,650	100.

Table A-20—Estimated employment attributed to timber in primary manufacturing industries in the
by region and State, 1972, 1967, and 1963

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	14,000	15,800	14,450
New Hampshire	3,700	3,850	3,850
Vermont	1,800	2,050	2,350
Massachusetts	6,800	9,450	10,300
Rhode Island	[1]	[1]	[1]
Connecticut	1,850	1,750	2,150
New York	12,700	14,700	16,050
New Jersey	5,000	5,700	6,350
Pennsylvania	13,750	15,250	14,950
Total	59,850	68,700	70,550
North Central:			
Ohio	11,650	12,600	11,000
Indiana	4,700	5,300	5,500
Illinois	4,100	4,950	4,500
Michigan	11,300	11,600	11,250
Wisconsin	19,800	21,250	21,450
Minnesota	6,300	6,200	6,300
Iowa	650	700	800
Missouri	2,400	3,150	3,300
North Dakota	[1]	[1]	[1]
South Dakota	[1]	[1]	[1]
Nebraska	[1]	[1]	[1]
Kansas	500	[1]	[1]
Total	61,800	66,550	64,850
Total, North	121,650	135,250	135,400
South:			
Southeast:			
Delaware	[1]	550	500
Maryland	3,400	3,450	3,400
Virginia	16,050	16,550	18,600
West Virginia	3,300	4,650	5,050
North Carolina	21,650	23,600	24,900
South Carolina	10,950	10,950	12,200
Georgia	19,300	17,450	20,100
Florida	10,050	9,900	11,350
Total	85,150	87,100	96,100

Region and State	1972	1967
South Central:		
Kentucky	5,250	4,
Tennessee	11,150	13,
Alabama	18,550	18,
Mississippi	14,600	12,
Arkansas	16,050	15,
Louisiana	16,350	14,
Oklahoma	2,200	2,
Texas	12,250	11,
Total	96,400	94,
Total, South	181,550	181,
West:		
Mountain:		
Montana	4,900	4,
Idaho	7,500	7,
Wyoming	[1]	
Colorado	1,250	1,
New Mexico	1,150	1,
Arizona	1,550	1,
Utah	500	
Nevada	[1]	
Total	16,950	17,
Pacific:		
Washington	33,050	33,
Oregon	46,150	46,
California	25,950	22,
Alaska	1,250	1,
Hawaii	[1]	
Total	106,400	103,
Total, West	123,350	121,
Total, United States	426,550	437,

[1] Less than 500 employees.

Note: Industry composition and definitions are given in Appendix B.

Sources: See table A-19.

Table A-21—Estimated value of shipments from selected manufacturing secondary[1] industries in the Un by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total	Millwork and prefabricated wood products	Wooden containers	Furnitur
			1972	
orth:				
Northeast	7,599,200	974,500	114,600	1,859,10
North Central	10,871,900	2,473,900	182,800	2,451,00
Total	18,471,100	3,448,400	297,400	4,310,10
outh:				
Southeast	6,474,600	1,469,600	126,000	2,763,75
South Central	5,444,000	1,394,300	222,100	1,719,25
Total	11,918,600	2,863,900	348,100	4,483,00
est:				
Mountain	616,600	409,700	5,500	127,70
Pacific	4,516,300	1,362,800	122,500	1,190,20
Total	5,132,900	1,772,500	128,000	1,317,90
otal, United States	35,522,600	8,084,800	773,500	10,111,00
			1967	
orth:				
Northeast	5,727,450	409,900	67,900	1,440,80
North Central	7,483,550	1,238,600	84,300	1,837,40
Total	13,211,000	1,648,500	152,200	3,278,20
outh:				
Southeast	3,631,150	471,300	87,450	1,712,80
South Central	2,973,600	417,400	172,050	1,082,60
Total	6,604,750	888,700	259,500	2,795,40
est:				
Mountain	252,950	113,900	5,700	61,70
Pacific	2,778,800	639,500	112,100	744,80
Total	3,031,750	753,400	117,800	806,50
otal, United States	22,847,500	3,290,600	529,500	6,880,10
			1963	
orth:				
Northeast	4,639,800	318,450	60,700	1,165,55
North Central	5,802,350	921,000	65,050	1,468,85
Total	10,442,150	1,239,450	125,750	2,634,40

Table A-22—Estimated value of shipments from selected secondary manufacturing industries[1] in by region and State, 1972, 1967, and 1963

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	172,050	119,100	79,500
New Hampshire	232,750	163,950	115,850
Vermont	157,000	103,100	74,300
Massachusetts	981,750	831,800	673,000
Rhode Island	83,900	61,350	49,250
Connecticut	319,000	226,850	192,050
New York	2,169,250	1,795,850	1,512,600
New Jersey	1,350,150	1,001,850	854,200
Pennsylvania	2,133,350	1,423,600	1,089,050
Total	7,599,200	5,727,450	4,639,800
North Central:			
Ohio	1,707,900	1,197,550	1,004,700
Indiana	1,634,150	1,055,800	796,200
Illinois	2,159,000	1,544,850	1,208,050
Michigan	1,313,150	1,004,050	916,300
Wisconsin	1,499,700	1,073,050	794,300
Minnesota	829,650	593,100	337,900
Iowa	390,450	228,000	169,200
Missouri	782,400	486,950	369,400
North Dakota	4,600	1,550	1,450
South Dakota	38,050	15,050	9,750
Nebraska	195,450	103,500	64,200
Kansas	317,400	180,100	130,900
Total	10,871,900	7,483,550	5,802,350
Total, North	18,471,100	13,211,000	10,442,150
South:			
Southeast:			
Delaware	41,400	32,950	16,200
Maryland	426,950	304,650	247,400
Virginia	1,079,500	652,750	483,300
West Virginia	167,050	46,400	37,900
North Carolina	1,921,900	1,169,500	794,600
South Carolina	467,550	229,750	173,250
Georgia	1,331,850	664,600	474,050
Florida	1,038,400	530,550	335,200
Total	6,474,600	3,630,150	2,561,900

Region and State	1972
South Central:	
Kentucky	390,750
Tennessee	1,136,200
Alabama	828,850
Mississippi	554,700
Arkansas	603,800
Louisiana	351,300
Oklahoma	175,250
Texas	1,403,150
Total	5,444,000
Total, South	11,918,600
West:	
Mountain:	
Montana	23,400
Idaho	154,850
Wyoming	600
Colorado	180,600
New Mexico	31,200
Arizona	141,650
Utah	75,200
Nevada	9,100
Total	616,600
Pacific:	
Washington	628,350
Oregon	493,050
California	3,329,500
Alaska	2,000
Hawaii	63,400
Total	4,516,300
Total, West	5,132,900
Total, United States	35,522,600

[1] Includes the millwork and prefabricated wood products, wooden containers, furniture, and paper and paperboard products industries as shown in

Sources: See table A-21.

Table A-23—Estimated value added in selected secondary manufacturing industries in the United by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total	Millwork and prefabricated wood products	Wooden containers	Furniture	Pa pap pr
			1972		
North:					
Northeast	9,586,300	448,100	52,700	974,800	2,
North Central	6,198,500	965,900	86,400	1,305,200	2,
Total	15,784,800	1,414,000	139,100	2,280,000	4,
South:					
Southeast	10,113,150	537,450	59,300	1,469,300	
South Central	4,828,700	494,050	107,300	932,400	
Total	14,941,850	1,031,500	166,600	2,401,700	1,
West:					
Mountain	344,600	153,600	2,000	69,000	
Pacific	2,928,250	528,300	51,100	644,200	
Total	3,272,850	681,900	53,100	713,200	
Total, United States	33,999,500	3,127,400	358,800	5,394,900	7,
			1967		
North:					
Northeast	8,908,200	169,300	34,700	760,800	1,
North Central	4,698,650	472,300	42,600	997,600	1,
Total	13,606,850	641,600	77,300	1,758,400	3,
South:					
Southeast	6,888,900	161,100	43,350	918,050	
South Central	3,403,250	141,600	75,650	540,450	
Total	10,292,150	302,700	119,000	1,458,500	1,
West:					
Mountain	146,150	41,200	2,650	30,900	
Pacific	1,873,050	259,300	39,650	410,100	
Total	2,019,200	300,500	42,300	441,000	
Total, United States	25,918,200	1,244,800	238,600	3,657,900	5,
			1963		
North:					
Northeast	7,227,350	129,700	28,000	610,150	1,
North Central	3,562,900	348,650	30,750	774,500	1,
Total	10,790,250	478,350	58,750	1,384,650	2,

Table A-24—Estimated value added in selected secondary manufacturing industries[1] in the United States, by regio

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	159,950	111,150	90,000
New Hampshire	153,550	133,000	100,700
Vermont	69,200	73,000	43,000
Massachusetts	1,073,300	982,900	795,600
Rhode Island	198,100	199,050	149,850
Connecticut	345,350	281,000	230,850
New York	3,715,500	3,629,600	3,018,750
New Jersey	1,373,450	1,237,400	1,022,150
Pennsylvania	2,497,900	2,261,100	1,776,450
Total	9,586,300	8,908,200	7,227,350
North Central:			
Ohio	1,054,400	865,000	703,250
Indiana	823,250	562,700	443,000
Illinois	1,383,000	1,028,350	788,550
Michigan	675,000	592,100	580,250
Wisconsin	718,600	531,100	283,950
Minnesota	485,350	362,950	213,650
Iowa	220,500	174,450	114,000
Missouri	576,250	406,000	315,500
North Dakota	5,000	500	550
South Dakota	23,100	9,900	3,550
Nebraska	81,950	55,150	35,450
Kansas	152,100	110,450	81,200
Total	6,198,500	4,698,650	3,562,900
Total, North	15,784,800	13,606,850	10,790,250
South:			
Southeast:			
Delaware	46,300	57,700	43,250
Maryland	400,800	335,050	269,050
Virginia	1,136,750	859,400	579,550
West Virginia	164,850	215,500	139,700
North Carolina	3,304,250	2,331,850	1,565,400
South Carolina	1,923,000	1,310,400	929,300
Georgia	2,441,300	1,430,750	989,100
Florida	695,900	348,250	199,400
Total	10,113,150	6,888,900	4,714,750

Region and State	1972
South Central:	
Kentucky	396,650
Tennessee	1,178,200
Alabama	1,018,900
Mississippi	518,150
Arkansas	414,750
Louisiana	207,000
Oklahoma	125,100
Texas	969,950
Total	4,828,700
Total, South	14,941,850
West:	
Mountain:	
Montana	10,400
Idaho	61,800
Wyoming	400
Colorado	104,450
New Mexico	16,400
Arizona	82,700
Utah	62,600
Nevada	5,850
Total	344,600
Pacific:	
Washington	317,300
Oregon	232,800
California	2,315,700
Alaska	1,500
Hawaii	60,950
Total	2,928,250
Total, West	3,272,850
Total, United States	33,999,500

[1] Includes the millwork and prefabricated wood products; wooden containers; furniture; paper and paperboard products; and fibers, plastics, and textiles in Appendix B.

Sources: See table A-23.

Table A-25—Estimated value added attributed to timber in secondary manufacturing industries in the U by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total	Millwork and prefabricated wood products	Wooden containers	Furniture	Paper and paperboard products
				1972	
orth:					
Northeast	3,224,350	303,050	48,300	294,150	1,509,450
North Central	3,217,400	608,450	78,850	384,900	1,769,500
Total	6,441,750	911,500	127,150	679,050	3,278,950
outh:					
Southeast	2,770,800	314,450	52,800	620,750	615,050
South Central	1,766,150	281,300	96,050	309,850	606,700
Total	4,536,950	595,750	148,850	930,600	1,221,750
'est:					
Mountain	167,200	96,450	1,800	19,950	24,750
Pacific	1,358,300	347,100	46,450	190,000	537,300
Total	1,525,500	443,550	48,250	209,950	562,050
otal, United States	12,504,200	1,950,800	324,250	1,819,600	5,062,750
				1967	
orth:					
Northeast	2,650,300	117,550	29,000	266,200	1,220,750
North Central	2,252,300	294,000	35,150	320,900	1,281,100
Total	4,902,600	411,550	64,150	587,100	2,501,850
outh:					
Southeast	1,768,500	94,700	35,400	437,500	381,550
South Central	1,141,150	79,200	61,850	202,350	356,700
Total	2,909,650	173,900	97,250	639,850	738,250
'est:					
Mountain	73,100	25,100	2,250	9,600	22,550
Pacific	880,900	167,950	33,400	138,800	363,050
Total	954,000	193,150	35,650	148,400	385,600
otal, United States	8,776,250	778,600	197,050	1,375,350	3,625,700
				1963	
orth:					
Northeast	2,150,450	93,800	23,550	214,400	972,350
North Central	1,684,400	214,200	25,750	241,700	977,250
Total	3,834,850	308,000	49,300	456,100	1,949,600

Table A-26—Estimated value added attributed to timber in secondary manufacturing industries by region and State, 1972, 1967, and 1963

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	89,600	59,400	43,450
New Hampshire	77,850	61,800	44,700
Vermont	43,900	39,950	27,400
Massachusetts	426,800	352,650	283,400
Rhode Island	54,250	45,600	35,850
Connecticut	127,850	103,150	86,750
New York	1,073,500	969,600	812,200
New Jersey	501,700	386,050	329,100
Pennsylvania	828,900	632,100	487,600
Total	3,224,350	2,650,300	2,150,450
North Central:			
Ohio	517,950	367,700	290,050
Indiana	427,350	275,550	198,150
Illinois	683,500	486,350	368,900
Michigan	393,650	298,600	252,750
Wisconsin	431,000	319,700	230,800
Minnesota	265,750	181,200	109,400
Iowa	124,000	74,600	50,250
Missouri	255,550	179,150	134,350
North Dakota	1,900	[1]	[1]
South Dakota	9,600	4,650	2,550
Nebraska	40,250	24,900	16,400
Kansas	66,900	39,450	30,350
Total	3,217,400	2,252,300	1,684,400
Total, North	6,441,750	4,902,600	3,834,850
South:			
Southeast:			
Delaware	18,250	13,600	8,850
Maryland	168,900	138,300	102,450
Virginia	431,750	296,350	214,800
West Virginia	74,150	48,900	46,800
North Carolina	819,550	584,550	406,700
South Carolina	416,600	237,950	192,300
Georgia	542,800	294,550	225,350
Florida	298,800	154,300	93,650
Total	2,770,800	1,768,500	1,290,900

Region and State	1972
South Central:	
Kentucky	142,500
Tennessee	393,900
Alabama	283,300
Mississippi	197,550
Arkansas	193,600
Louisiana	99,450
Oklahoma	48,750
Texas	407,100
Total	1,766,150
Total, South	4,536,950
West:	
Mountain:	
Montana	8,700
Idaho	32,300
Wyoming	2,350
Colorado	50,350
New Mexico	8,750
Arizona	37,950
Utah	23,100
Nevada	3,700
Total	167,200
Pacific:	
Washington	192,300
Oregon	157,450
California	981,150
Alaska	850
Hawaii	26,550
Total	1,358,300
Total, West	1,525,500
Total, United States	12,504,200

[1] Less than 500 thousand dollars.

Note: Industry composition and definitions are given in Appendix B.

Sources: See table A-25.

Table A-27—Estimated employment in selected secondary manufacturing industries in the United by industry and region, 1972, 1967, and 1963

(Number)

Region	Total	Millwork and prefabricated wood products	Wooden containers	Furniture	Pap pape pro
			1972		
North:					
Northeast	769,350	28,900	5,400	72,350	1
North Central	406,450	61,500	8,700	93,750	1
Total	1,175,800	90,400	14,100	166,100	2
South:					
Southeast	884,550	40,950	7,500	123,800	
South Central	449,650	40,350	11,000	81,700	
Total	1,334,200	81,300	18,500	205,500	1
West:					
Mountain	30,700	11,650	[1]	5,400	
Pacific	202,700	35,950	4,100	45,700	
Total	233,400	47,600	4,300	51,100	
Total, United States	2,743,400	219,300	36,900	422,700	4
			1967		
North:					
Northeast	923,500	15,800	4,400	77,600	1
North Central	410,400	44,000	5,000	94,600	1
Total	1,333,900	59,800	9,400	172,200	2
South:					
Southeast	821,350	18,200	7,550	105,650	
South Central	395,050	17,700	9,550	68,050	
Total	1,216,400	35,900	17,100	173,700	
West:					
Mountain	17,950	4,800	[1]	3,450	
Pacific	167,450	24,200	4,450	37,350	
Total	185,400	29,000	4,800	4,800	
Total, United States	2,735,700	124,700	31,300	386,700	4
			1963		
North:					
Northeast	926,800	14,200	4,700	74,600	1
North Central	384,200	38,150	5,000	88,500	1

Table A-28—Estimated employment in selected secondary manufacturing industries[1] in the United States, by reg

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	11,800	12,300	12,200
New Hampshire	10,900	13,300	12,850
Vermont	6,000	7,500	5,200
Massachusetts	82,150	107,050	106,000
Rhode Island	15,850	20,400	19,300
Connecticut	27,700	29,950	30,050
New York	277,850	345,500	361,700
New Jersey	105,700	114,150	119,200
Pennsylvania	231,400	273,350	260,300
Total	769,350	923,500	926,800
North Central:			
Ohio	66,150	70,850	70,350
Indiana	58,100	54,750	49,950
Illinois	90,900	94,950	90,250
Michigan	43,700	50,400	48,850
Wisconsin	44,250	44,850	37,300
Minnesota	27,050	23,400	21,350
Iowa	14,500	13,150	10,900
Missouri	43,100	41,850	41,800
North Dakota	[2]	[2]	[2]
South Dakota	2,000	1,100	350
Nebraska	5,700	5,000	4,400
Kansas	10,600	10,000	8,600
Total	406,450	410,400	384,200
Total, North	1,175,800	1,333,900	1,311,000
South:			
Southeast:			
Delaware	3,750	5,150	3,750
Maryland	32,100	35,350	34,400
Virginia	100,150	97,650	80,250
West Virginia	13,250	14,900	12,050
North Carolina	319,150	297,500	241,400
South Carolina	170,500	161,650	144,050
Georgia	188,850	169,250	150,450
Florida	56,800	39,900	29,900
Total	884,550	821,350	696,250

Region and State	1972
South Central:	
Kentucky	33,600
Tennessee	108,150
Alabama	98,000
Mississippi	52,750
Arkansas	35,700
Louisiana	16,950
Oklahoma	11,700
Texas	92,800
Total	449,650
Total, South	1,334,200
West:	
Mountain:	
Montana	750
Idaho	4,400
Wyoming	[2]
Colorado	8,200
New Mexico	1,350
Arizona	8,250
Utah	7,150
Nevada	550
Total	30,700
Pacific:	
Washington	19,800
Oregon	15,350
California	162,900
Alaska	[2]
Hawaii	4,550
Total	202,700
Total, West	233,400
Total, United States	2,743,400

[1] Includes the millwork and prefabricated wood products; wooden containers; furniture; paper and paperboard products; and fibers, plastics, and text
in Appendix B.

[2] Less than 500 employees.

Sources: See table A-27.

Table A-29—Estimated employment attributed to timber in secondary manufacturing industries in the U
by industry and region, 1972, 1967, and 1963

(Number)

Region	Total	Millwork and prefabricated wood products	Wooden containers	Furniture	Paper and paperboard products
				1972	
North:					
Northeast	232,600	19,600	4,950	23,450	88,600
North Central	200,650	39,200	7,950	30,150	94,600
Total	433,250	58,800	12,900	53,600	183,200
South:					
Southeast	224,600	24,400	6,650	52,450	35,450
South Central	142,950	23,000	9,850	28,950	32,250
Total	367,550	47,400	16,500	81,400	67,700
West:					
Mountain	13,650	7,300	[1]	1,700	2,050
Pacific	85,950	23,600	3,700	14,400	25,450
Total	99,600	30,900	3,900	16,100	27,500
Total, United States	900,400	137,100	33,300	151,100	278,400
				1967	
North:					
Northeast	256,250	11,000	3,650	28,750	96,450
North Central	193,900	27,200	4,150	33,100	95,650
Total	450,150	38,200	7,800	61,850	192,100
South:					
Southeast	196,850	10,900	6,200	50,700	32,750
South Central	122,100	10,650	7,800	27,150	25,300
Total	318,950	21,550	14,000	77,850	58,050
West:					
Mountain	7,800	2,950	[1]	1,100	1,600
Pacific	74,050	15,250	3,750	13,250	24,600
Total	81,850	18,200	4,050	14,350	26,200
Total, United States	850,950	77,950	25,850	154,050	276,350
				1963	
North:					
Northeast	256,600	10,350	3,950	28,000	92,600
North Central	178,100	24,050	4,200	30,350	89,300
Total	434,700	34,400	8,150	58,350	181,900
South:					

**Table A-30—Estimated employment attributed to timber in secondary manufacturing indust
by region and State, 1972, 1967, and 1963**

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	6,000	6,650	5,850
New Hampshire	5,600	5,700	5,500
Vermont	3,500	3,550	3,150
Massachusetts	29,950	35,550	35,250
Rhode Island	4,000	4,800	4,750
Connecticut	9,450	10,000	10,100
New York	77,400	89,550	93,750
New Jersey	33,200	33,200	35,400
Pennsylvania	63,500	67,250	62,850
Total	232,600	256,250	256,600
North Central:			
Ohio	31,600	30,850	30,050
Indiana	28,900	26,900	23,400
Illinois	42,900	44,150	40,500
Michigan	24,650	26,550	25,350
Wisconsin	25,300	25,700	22,500
Minnesota	13,900	11,100	9,800
Iowa	7,850	5,950	5,150
Missouri	17,600	16,300	15,700
North Dakota	[1]	[1]	[1]
South Dakota	650	[1]	[1]
Nebraska	2,700	2,300	2,050
Kansas	4,450	3,600	3,250
Total	200,650	193,900	178,100
Total, North	433,250	450,150	434,700
South:			
Southeast:			
Delaware	1,350	1,500	950
Maryland	12,250	13,150	11,850
Virginia	35,400	31,250	26,650
West Virginia	5,150	4,150	4,250
North Carolina	76,800	70,600	59,250
South Carolina	33,700	27,800	26,400
Georgia	37,950	32,500	30,950
Florida	22,000	15,900	13,250
Total	224,600	196,850	173,550

Region and State	1972
South Central:	
Kentucky	10,40
Tennessee	31,95
Alabama	22,60
Mississippi	17,50
Arkansas	14,75
Louisiana	7,20
Oklahoma	4,25
Texas	34,30
Total	142,95
Total, South	367,55
West:	
Mountain:	
Montana	60
Idaho	2,35
Wyoming	
Colorado	3,95
New Mexico	70
Arizona	3,35
Utah	2,20
Nevada	
Total	13,65
Pacific:	
Washington	10,85
Oregon	9,75
California	63,55
Alaska	
Hawaii	1,75
Total	85,95
Total, West	99,60
Total, United States	900,40

[1] Less than 500 employees.

Note: Industry composition and definitions are given in Appendix B.

Sources: See table A-29.

Table A-31—Value of new construction put in place in the United States, by type, 1963–72

(Million dollars)

Type of construction	1963	1964	1965	1966	1967	1968	1969	1970
Private:								
Residential buildings[1]	27,874	28,010	27,934	25,715	25,568	30,565	33,200	31,864
Nonresidential buildings	11,646	12,955	16,509	18,279	17,589	18,164	21,155	21,417
Utilities	4,667	5,031	5,788	6,803	7,603	8,969	9,535	11,020
Other	1,268	1,296	1,454	1,610	1,786	1,790	2,063	2,458
Total	45,455	47,292	51,685	52,407	52,546	59,488	65,953	66,759
Public:								
Buildings	6,534	7,177	7,893	8,920	9,982	10,439	11,230	10,657
Highways and streets	7,084	7,133	7,550	8,405	8,591	9,321	9,250	9,981
Other	5,739	6,073	6,619	6,682	6,963	7,845	7,484	7,458
Total	19,357	20,383	22,062	24,007	25,536	27,605	27,964	28,096
Total, all types	64,812	67,675	73,747	76,414	78,082	87,093	93,917	94,855

[1] Includes additions and alterations.

Note: Data shown in this table do not include the value of maintenance and repair construction of existing residential and nonresidential structures, estimated million in 1967, and $35,000 million in 1972.

Source: U.S. Department of Commerce, Bureau of the Census. *Value of new construction put in place.* Constr. Reps. C39-76-4, 1976.

Footnotes for Table A-39, page 71.

[1] Less than 500 employees.

Sources: *Railroad*—Estimates of State and regional employment in railroad freight operations were derived by (1) distributing total U.S. employment in railroad and 1963 editions of *Employment and Earnings,* published by the U.S. Department of Labor, Bureau of Labor Statistics, using the State and regional distribution covered by the Railroad Retirement and Railroad Unemployment Insurance Acts and (2) adjusting these estimates by the proportion of total railroad revenues due 1972, 91.5 percent in 1967, and 88.4 precent in 1963). These ratios were calculated, by region, from data in the 1972, 1967, and 1963 editions of *Transport Statistics* U.S. Interstate Commerce Commission. Estimates of value added attributed to timber were derived by adjusting the value added in railroad freight operations by th that were derived from timber products (13.5 percent in 1972, 12.2 percent in 1967, and 13.8 percent in 1963). These ratios were calculated from data on freight rev published by the U.S. Interstate Commerce Commission, Bureau of Accounts in the 1972, 1967, and 1963 editions of *Freight Commodity Statistics.*

Truck—Estimates of total employment in truck freight transportation and warehousing by State and region were derived from data on total U.S. employment covered by State Unemployment Insurance Laws and Unemployment Compensation for Federal Employees programs, published in the U.S. Department of Labo tions *Employment and Earnings* and *Employment and Wages.* Estimates of employment attributed to timber were derived by adjusting the total estimated employ the proportion of total freight revenues that were derived from timber products (5.7 percent in 1972, 5.6 percent in 1967, and 7.2 percent in 1963). These ratios revenues by commodity class and region published by the U.S. Interstate Commerce Commission, Bureau of Accounts in the 1972, 1967, and 1963 editions of

Water—Estimates of total employment in water freight transportation by State and region were derived from data on total U.S. employment, and State and r Employment Insurance Laws and Unemployment Compensation for Federal Employees programs, published in the U.S. Department of Labor Statistics publica *Employment and Wages.* Estimates of employment attributed to timber were derived by adjusting the total estimated employment in water transportation by the pr were derived from timber products (10.3 percent in 1972, 11.3 percent in 1967, and 17.1 percent in 1963). These ratios were calculated from data on water freight rev for 1963) published by the U.S. Interstate Commerce Commission, Bureau of Accounts in 1972, 1967, and 1963 editions of *Freight Commodity Statistics.*

Table A-32—Housing starts in the United States, by region, 1963–72

(Thousand units)

Region	1963	1964	1965	1966	1967	1968	1969
Northeast	271.4	262.7	281.3	215.6	223.5	236.4	212.9
North Central	335.9	346.5	368.7	297.3	343.9	377.0	356.6
Total, North	607.3	609.2	650.0	512.9	567.4	613.4	569.5
South	595.8	589.8	588.6	482.9	531.5	633.7	602.9
West	431.8	362.0	271.1	200.0	223.0	298.3	327.2
Total, United States	1,634.9	1,561.0	1,509.7	1,195.8	1,321.9	1,545.4	1,499.5

Note: Data may not add to totals due to rounding.

Source: U.S. Department of Commerce, Bureau of the Census, *Housing starts.* Constr. Rep. Ser. C20-76-8, 1976.

Footnotes for Table A-36, page 67.

[1] Less than $500,000.

Sources: *Railroad*—Estimates of total U.S. value added in railroad freight operations were derived by adjusting total value added in railroad transp the *Input-output Structure of the U.S. Economy* published by the U.S. Department of Commerce, Bureau of Economic Analysis, by the proportion (95.9 percent in 1972, 91.5 percent in 1967, and 88.4 percent in 1963). These ratios were calculated, by region, from dta in the 1972, 1967, and 1963 e published by the U.S. Interstate Commerce Commission, Bureau of Accounts. The State and regional distribution of value added due to freight operat Department of Commerce, Bureau of Economic Analysis showing income in railroad transportation by place of work. Estimates of value added attrit value added in railroad freight operations by the proportion of total freight revenues that were derived from timber product (13.5 percent in 1972, 12. ratios were calculated from data on freight revenues by commodity class and region published by the U.S. Interstate Commerce Commission, Bureau c *Freight Commodity Statistics.*

Truck—Estimates of total U.S. value added in truck freight transportation and warehousing were derived from the 1972, 1967, and 1963 editions c published by the U.S. Department of Commerce, Bureau of Economic Analysis. State and regional estimates of value added were based on unpublish Bureau of Economic Analysis showing income in trucking and warehousing by place of work. Estimates of value added attributed to timber were der and warehousing by the proportion of total freight revenues that were derived from timber products (5.7 percent in 1972, 5.6 percent in 1967, and 7.2 data on freight revenues by commodity class and region published by the U.S. Interstate Commerce Commission, Bureau of Accounts in the 1972 *Statistics.*

Water—Estimates of total U.S. value added in water freight transportation were derived from the 1972, 1967, and 1963 editions of the *Input-ou* U.S. Department of Commerce, Bureau of Economic Analysis. State and regional estimates of value added were based on unpublished data fror Economic Analysis showing income in water transportation by place of work. Estimates of value added attributed to timber were derived by adjusting portion of total domestic freight revenues for inland, coastal, and maritime carriers by water that were derived from timber products (10.3 percent 1963). These ratios were calculated from data on water freight revenues by commodity class (and region for 1963) published by the U.S. Interstate C 1972, 1967, and 1963 editions of *Freight Commodity Statistics.*

Sources for Table A-37, page 68.

Sources: *Retail trade*—Estimates of total U.S. value added were derived from unpublished data on gross product originating in retail trade fro

d value added attributed to timber in construction in the United States, by region and State, 1972, 1967, and 1963

(Thousand dollars)

	1967		1963	
	Value added		Value added	
	Total	Attributed to timber	Total	Attributed to timber
0	166,100	19,950	126,900	19,700
0	158,100	25,300	110,450	17,150
0	82,400	15,650	51,450	8,000
0	1,384,850	180,000	1,128,800	174,950
0	240,800	33,700	176,750	27,400
0	907,350	145,150	743,700	115,250
0	4,502,650	918,650	4,310,100	701,000
0	1,821,700	273,300	1,498,800	232,300
0	3,015,250	361,850	2,298,550	348,700
0	12,279,200	1,973,550	10,445.500	1,644,450
0	2,572,700	334,450	1,917,300	295,250
0	1,210,550	157,400	833,000	128,300
0	3,274,850	327,500	2,503,550	385,550
0	2,192,850	307,000	1,470,550	226,450
0	1,008,300	151,200	759,150	116,900
0	1,054,650	84,400	811,650	125,000
0	634,300	82,450	467,000	71,950
0	1,084,550	151,850	945,000	145,100
0	128,050	12,800	144,200	22,200
0	117,000	11,700	154,100	23,700
0	373,950	41,150	342,700	52,800
0	485,550	53,400	470,000	72,400
0	14,137,300	1,715,300	10,818,200	1,665,600
0	26,416,500	3,688,850	21,263,700	3,310,050
0	268,400	21,450	227,250	29,500
0	1,032,200	154,850	835,300	108,600
0	978,350	156,550	846,900	110,100
0	287,400	23,000	183,200	23,800
0	987,600	128,400	684,950	89,000
0	636,100	76,350	405,050	58,800
0	981,050	127,550	695,600	90,450
0	1,636,950	278,300	1,294,800	168,350
0	6,808,050	966,450	5,173,050	678,600

Region and State	1972		1967		1963	
	Value added		Value added		Value added	
	Total	Attributed to timber	Total	Attributed to timber	Total	Attributed to timber
South Central:						
Kentucky	911,900	118,500	557,550	66,900	444,950	57,850
Tennessee	1,302,650	169,350	789,600	102,650	586,450	76,200
Alabama	1,015,200	142,150	604,250	72,500	435,300	56,600
Mississippi	518,750	83,000	306,500	42,900	217,950	28,350
Arkansas	509,200	81,500	306,650	39,900	232,600	30,250
Louisiana	1,412,700	183,650	940,850	112,900	503,850	65,500
Oklahoma	884,500	123,850	510,200	61,200	490,800	63,800
Texas	5,018,400	702,600	3,051,550	335,650	2,171,350	282,250
Total	11,573,300	1,604,600	7,067,150	834,600	5,083,250	660,800
Total, South	24,447,550	3,813,250	13,875,200	1,801,050	10,256,300	1,339,400
West:						
Mountain:						
Montana	218,350	26,200	141,700	17,000	139,700	23,050
Idaho	345,300	44,900	206,050	20,600	171,350	28,300
Wyoming	150,550	18,100	79,950	4,000	101,150	16,700
Colorado	1,368,950	246,350	619,100	86,650	577,400	95,250
New Mexico	345,300	65,600	182,350	23,750	186,050	30,650
Arizona	1,247,000	274,350	386,350	54,050	418,550	69,100
Utah	485,750	72,850	233,500	25,650	262,450	43,300
Nevada	416,300	83,250	220,950	24,350	385,800	63,650
Total	4,577,500	831,600	2,069,950	256,060	2,242,450	370,000
Pacific:						
Washington	1,339,450	174,100	1,028,500	133,750	728,650	120,250
Oregon	836,250	133,800	499,700	59,950	436,400	72,000
California	8,513,500	1,362,200	5,689,300	739,600	5,932,950	978,900
Alaska	237,400	33,250	128,900	9,000	78,700	13,000
Hawaii	537,000	96,650	261,850	44,550	199,750	33,000
Total	11,463,600	1,800,000	7,608,250	986,850	7,376,450	1,217,150
Total, West	16,041,100	2,631,600	9,678,200	1,242,900	9,618,900	1,587,150
Total, United States	79,601,400	11,947,250	49,969,900	6,732,800	41,138,900	6,236,600

d employment attributed to timber in construction in the United States, by region and State, 1972, 1967, and 1963

(Number)

1967 Employment Total	1967 Employment Attributed to timber	1963 Employment Total	1963 Employment Attributed to timber
21,150	2,550	20,550	3,150
17,550	2,850	16,100	2,500
10,800	2,050	9,250	1,400
123,400	16,050	123,100	19,100
23,500	3,300	18,850	2,950
73,700	11,800	82,850	12,850
363,400	47,200	384,600	59,650
149,300	22,400	147,800	22,950
284,650	34,150	216,150	33,450
1,067,450	142,350	1,019,200	158,000
217,500	28,300	196,050	30,200
108,300	14,050	94,250	14,650
246,500	24,650	219,350	33,800
166,900	23,350	139,100	21,400
87,800	13,150	84,750	13,050
88,700	7,100	77,800	11,950
64,100	8,350	56,000	8,600
103,300	14,450	105,850	16,300
13,050	1,300	17,300	2,700
1,300	18,400	18,400	2,800
36,700	4,050	39,700	6,100
50,900	5,600	54,400	8,350
1,196,550	145,650	1,102,950	169,900
2,264,000	288,000	2,122,150	327,900
24,650	2,000	18,950	2,500
99,900	15,000	98,650	12,800
116,800	14,000	119,700	15,550
29,350	4,100	28,250	3,650
129,600	16,850	107,450	13,950
69,100	8,300	52,150	6,800

Region and State	1972 Employment Total	1972 Employment Attributed to timber	1967 Employment Total	1967 Employment Attributed to timber	1963 Employment Total	1963 Employment Attributed to timber
South Central:						
Kentucky	71,150	9,250	62,450	7,500	70,350	9,150
Tennessee	111,850	15,650	98,450	12,800	80,700	10,500
Alabama	85,450	12,000	71,100	8,500	63,400	8,250
Mississippi	48,650	7,800	36,500	5,100	39,650	5,200
Arkansas	49,550	7,900	41,000	5,350	46,200	6,050
Louisiana	104,750	13,650	91,600	11,000	79,100	10,300
Oklahoma	74,900	10,500	59,550	7,150	62,100	8,050
Texas	400,600	56,100	327,100	36,000	255,350	33,150
Total	946,900	132,850	787,750	93,400	696,850	90,650
Total, South	1,965,250	307,550	1,536,650	173,650	1,389,200	180,650
West:						
Mountain:						
Montana	15,300	1,800	13,750	1,700	19,250	3,150
Idaho	23,550	3,050	16,150	1,600	13,850	2,250
Wyoming	8,000	1,000	6,350		12,500	2,100
Colorado	95,550	17,200	57,400	8,050	57,300	9,450
New Mexico	28,950	5,500	19,550	2,550	26,550	4,400
Arizona	65,500	14,400	33,100	4,600	43,400	7,200
Utah	32,100	4,850	21,700	2,400	27,500	4,500
Nevada	22,000	4,400	15,450	1,700	22,200	3,650
Total	290,950	52,200	183,450	22,950	222,550	36,700
Pacific:						
Washington	81,550	10,600	81,200	10,550	65,350	10,800
Oregon	53,950	8,650	43,450	5,200	47,700	7,850
California	445,650	71,300	389,950	51,850	478,350	78,900
Alaska	9,100	1,250	5,650		6,550	1,100
Hawaii	28,250	5,050	19,300	3,300	19,450	3,250
Total	618,500	96,850	548,550	71,300	617,400	101,900
Total, West	909,450	149,050	732,000	94,250	839,950	138,600
Total, United States	5,278,050	795,250	4,532,650	555,900	4,351,300	647,150

egion and State	Value added	Value added attributed to timber	Value added	Value added attributed to timber	Value added	Value added attributed to timber	Value added	Value added attributed to timber	Value added	Valu att to
orth:										
Northeast:										
Maine	599,000	28,000	126,000	9,000	473,000	19,000	492,000	21,000	85,000	
New Hampshire	600,000	31,000	59,000	4,000	541,000	27,000	343,000	16,000	34,000	
Vermont	353,000	18,000	54,000	4,000	299,000	14,000	211,000	10,000	33,000	
Massachusetts	5,706,000	250,000	654,000	42,000	5,052,000	208,000	3,836,000	183,000	444,000	
Rhode Island	786,000	37,000	96,000	6,000	690,000	31,000	540,000	25,000	66,000	
Connecticut	2,841,000	137,000	293,000	19,000	2,548,000	118,000	1,846,000	91,000	200,000	
New York	20,021,000	965,000	2,384,000	174,000	17,637,000	791,000	14,815,000	831,000	2,091,000	
New Jersey	8,101,000	337,000	1,437,000	95,000	6,664,000	242,000	4,949,000	234,000	932,000	
Pennsylvania	10,598,000	458,000	2,115,000	149,000	8,483,000	309,000	7,304,000	348,000	1,472,000	
Total	49,605,000	2,261,000	7,218,800	502,000	42,387,000	1,759,000	34,336,000	1,759,000	5,357,000	
North Central:										
Ohio	10,202,000	418,000	1,977,000	135,000	8,225,000	283,000	6,855,000	326,000	1,257,000	
Indiana	4,613,000	191,000	849,000	58,000	3,764,000	133,000	3,098,000	138,000	548,000	
Illinois	12,764,000	543,000	2,220,000	157,000	10,544,000	386,000	9,110,000	376,000	1,607,000	
Michigan	7,657,000	307,000	1,043,000	70,000	6,614,000	237,000	5,194,000	227,000	708,000	
Wisconsin	3,772,000	182,000	633,000	58,000	3,139,000	124,000	2,473,000	124,000	382,000	
Minnesota	3,898,000	207,000	713,000	78,000	3,185,000	129,000	2,504,000	131,000	424,000	
Iowa	2,511,000	109,000	471,000	46,000	2,040,000	63,000	1,621,000	75,000	262,000	
Missouri	4,923,000	230,000	955,000	94,000	3,968,000	136,000	3,382,000	169,000	617,000	
North Dakota	531,000	28,000	99,000	12,000	432,000	16,000	352,000	17,000	62,000	
South Dakota	486,000	19,000	88,000	7,000	398,000	12,000	313,000	13,000	43,000	
Nebraska	1,526,000	83,000	385,000	46,000	1,141,000	37,000	974,000	54,000	217,000	
Kansas	2,048,000	109,000	516,000	61,000	1,532,000	48,000	1,304,000	71,000	322,000	
Total	54,931,000	2,426,000	9,949,000	822,000	44,982,000	1,604,000	37,180,000	1,721,000	6,449,000	
Total, North	104,536,000	4,687,000	17,167,000	1,324,000	87,369,000	3,363,000	71,516,000	3,480,000	11,806,000	
outh:										
Southeast:										
Delaware	642,000	24,000	84,000	6,000	558,000	18,000	413,000	19,000	64,000	
Maryland	4,517,000	191,000	704,000	50,000	3,813,000	141,000	3,000,000	140,000	498,000	
Virginia	3,919,000	256,000	774,000	79,000	3,145,000	177,000	2,323,000	133,000	491,000	
West Virginia	1,234,000	68,000	301,000	35,000	933,000	33,000	832,000	52,000	218,000	
North Carolina	4,338,000	228,000	830,000	64,000	3,508,000	164,000	2,524,000	136,000	471,000	
South Carolina	1,744,000	94,000	305,000	28,000	1,439,000	66,000	972,000	49,000	158,000	
Georgia	4,530,000	258,000	782,000	74,000	3,748,000	184,000	2,633,000	145,000	454,000	
Florida	6,876,000	318,000	862,000	79,000	6,014,000	239,000	3,675,000	175,000	447,000	
Total	27,800,000	1,437,000	4,642,000	415,000	23,158,000	1,022,000	16,372,000	849,000	2,801,000	
South Central:										
Kentucky	2,339,000	123,000	524,000	59,000	1,815,000	64,000	1,422,000	81,000	324,000	
Tennessee	3,515,000	171,000	689,000	61,000	2,826,000	110,000	2,083,000	109,000	394,000	
Alabama	2,433,000	144,000	480,000	47,000	1,953,000	97,000	1,468,000	82,000	296,000	
Mississippi	1,151,000	65,000	253,000	24,000	898,000	41,000	757,000	43,000	136,000	
Arkansas	1,323,000	73,000	310,000	32,000	1,013,000	41,000	793,000	41,000	186,000	
Louisiana	3,130,000	164,000	756,000	75,000	2,374,000	89,000	2,051,000	118,000	548,000	
Oklahoma	1,985,000	90,000	339,000	28,000	1,646,000	62,000	1,199,000	55,000	182,000	
Texas	10,824,000	516,000	1,901,000	179,000	8,923,000	337,000	6,565,000	326,000	1,247,000	
Total	26,700,000	1,346,000	5,252,000	505,000	21,448,000	841,000	16,338,000	855,000	3,313,000	
Total, South	54,500,000	2,783,000	9,894,000	920,000	44,606,000	1,863,000	32,710,000	1,704,000	6,114,000	
est:										
Mountain:										
Montana	651,000	44,000	175,000	22,000	476,000	22,000	423,000	24,000	107,000	
Idaho	643,000	40,000	132,000	15,000	511,000	25,000	393,000	20,000	74,000	
Wyoming	312,000	20,000	102,000	13,000	210,000	7,000	190,000	12,000	64,000	
Colorado	2,335,000	120,000	328,000	31,000	2,007,000	89,000	1,322,000	65,000	210,000	
New Mexico	732,000	40,000	122,000	13,000	610,000	27,000	452,000	24,000	84,000	
Arizona	1,618,000	78,000	171,000	17,000	1,447,000	61,000	857,000	38,000	102,000	
Utah	998,000	55,000	220,000	22,000	778,000	33,000	612,000	37,000	139,000	
Nevada	528,000	25,000	66,000	7,000	462,000	18,000	303,000	15,000	43,000	
Total	7,817,000	422,000	1,316,000	140,000	6,501,000	282,000	4,552,000	235,000	823,000	
Pacific:										
Washington	3,316,000	232,000	569,000	59,000	2,747,000	173,000	2,276,000	155,000	395,000	
Oregon	2,395,000	189,000	448,000	44,000	1,947,000	145,000	1,498,000	129,000	290,000	

Region and State	1963					
	Total		Transportation		Marketing	
	Value added	Value added attributed to timber	Value added	Value added attributed to timber	Value added	Value added attributed to timber
North:						
Northeast:						
Maine	391,000	25,000	73,000	13,000	318,000	12,000
New Hampshire	245,000	14,000	29,000	3,000	216,000	11,000
Vermont	154,000	10,000	32,000	5,000	122,000	5,000
Massachusetts	2,995,000	184,000	376,000	46,000	2,619,000	138,000
Rhode Island	407,000	24,000	53,000	6,000	354,000	18,000
Connecticut	1,366,000	80,000	161,000	22,000	1,205,000	58,000
New York	11,895,000	741,000	1,778,000	195,000	10,117,000	546,000
New Jersey	3,708,000	207,000	712,000	67,000	2,996,000	140,000
Pennsylvania	5,685,000	309,000	1,256,000	114,000	4,428,000	195,000
Total	26,845,000	1,594,000	4,470,000	471,000	22,375,000	1,123,000
North Central:						
Ohio	5,184,000	258,000	1,018,000	81,000	4,166,000	177,000
Indiana	2,290,000	113,000	435,000	32,000	1,855,000	81,000
Illinois	6,816,000	336,000	1,323,000	101,000	5,493,000	235,000
Michigan	3,695,000	171,000	535,000	45,000	3,160,000	126,000
Wisconsin	1,846,000	116,000	304,000	45,000	1,542,000	71,000
Minnesota	1,920,000	132,000	336,000	61,000	1,584,000	71,000
Iowa	1,239,000	75,000	214,000	38,000	1,025,000	37,000
Missouri	2,635,000	135,000	500,000	48,000	2,135,000	87,000
North Dakota	288,000	20,000	54,000	11,000	234,000	9,000
South Dakota	263,000	15,000	39,000	6,000	224,000	9,000
Nebraska	789,000	49,000	193,000	25,000	596,000	24,000
Kansas	1,033,000	61,000	265,000	34,000	768,000	27,000
Total	27,998,000	1,481,000	5,216,000	527,000	22,782,000	954,000
Total, North	54,843,000	3,075,000	9,686,000	998,000	45,157,000	2,077,000
South:						
Southeast:						
Delaware	294,000	16,000	50,000	4,000	244,000	12,000
Maryland	2,308,000	119,000	408,000	36,000	1,900,000	83,000
Virginia	1,728,000	90,000	383,000	29,000	1,345,000	61,000
West Virginia	660,000	32,000	179,000	12,000	481,000	20,000
North Carolina	1,770,000	100,000	333,000	32,000	1,437,000	68,000
South Carolina	674,000	38,000	117,000	13,000	557,000	25,000
Georgia	1,842,000	110,000	354,000	41,000	1,488,000	69,000
Florida	2,526,000	124,000	322,000	39,000	2,204,000	85,000
Total	11,802,000	629,000	2,146,000	206,000	9,656,000	423,000
South Central:						
Kentucky	1,087,000	71,000	262,000	36,000	825,000	35,000
Tennessee	1,505,000	89,000	301,000	34,000	1,204,000	55,000
Alabama	1,111,000	69,000	241,000	30,000	870,000	39,000
Mississippi	562,000	35,000	111,000	14,000	451,000	21,000
Arkansas	606,000	34,000	145,000	14,000	461,000	20,000
Louisiana	1,468,000	96,000	401,000	52,000	1,067,000	44,000
Oklahoma	959,000	48,000	148,000	13,000	811,000	35,000
Texas	4,944,000	264,000	942,000	99,000	4,002,000	165,000
Total	12,242,000	706,000	2,551,000	292,000	9,691,000	414,000
Total, South	24,044,000	1,335,000	4,697,000	498,000	19,347,000	837,000
West:						
Mountain:						
Montana	348,000	29,000	88,000	18,000	260,000	11,000
Idaho	328,000	19,000	72,000	9,000	256,000	10,000
Wyoming	177,000	12,000	59,000	8,000	118,000	4,000
Colorado	1,072,000	59,000	186,000	21,000	886,000	38,000
New Mexico	388,000	23,000	75,000	9,000	313,000	14,000
Arizona	683,000	34,000	89,000	10,000	594,000	24,000
Utah	511,000	35,000	111,000	14,000	400,000	21,000

Table A-36—Estimated value added and value added attributed to timber in transportation in the Unit
by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total		Railroad		Truck	
	Value added	Value added attributed to timber	Value added	Value added attributed to timber	Value added	Value added attributed to timber
			1972			
orth:						
Northeast	7,218,000	502,000	1,691,000	148,000	4,673,000	266,000
North Central	9,949,000	822,000	3,757,000	457,000	5,914,000	337,000
Total	17,167,000	1,324,000	5,448,000	605,000	10,587,000	603,000
uth:						
Southeast	4,642,000	415,000	1,359,000	209,000	2,878,000	164,000
South Central	5,252,000	505,000	1,580,000	264,000	2,959,000	168,000
Total	9,894,000	920,000	2,939,000	473,000	5,837,000	332,000
est:						
Mountain	1,316,000	140,000	591,000	99,000	722,000	41,000
Pacific	3,693,000	345,000	1,033,000	172,000	2,206,000	126,000
Total	5,009,000	485,000	1,624,000	271,000	2,928,000	167,000
otal, United States	32,070,000	2,729,000	10,011,000	1,349,000	19,352,000	1,102,000
			1967			
orth:						
Northeast	5,357,000	396,000	1,452,000	118,000	2,885,000	162,000
North Central	6,449,000	528,000	2,776,000	310,000	3,470,000	195,000
Total	11,806,000	924,000	4,228,000	428,000	6,355,000	357,000
uth:						
Southeast	2,801,000	254,000	965,000	134,000	1,556,000	88,000
South Central	3,313,000	326,000	1,054,000	163,000	1,631,000	92,000
Total	6,114,000	580,000	2,019,000	297,000	3,187,000	180,000
est:						
Mountain	823,000	91,000	441,000	69,000	381,000	22,000
Pacific	2,490,000	240,000	738,000	115,000	1,291,000	73,000
Total	3,313,000	331,000	1,179,000	184,000	1,672,000	95,000
otal, United States	21,233,000	1,835,000	7,426,000	909,000	11,214,000	632,000
			1963			
orth:						
Northeast	4,470,000	471,000	1,370,000	168,000	2,283,000	163,000
North Central	5,216,000	527,000	2,462,000	314,000	2,602,000	187,000

Table A-37—Estimated value added and value added attributed to timber in marketing i… by industry and region, 1972, 1967, and 1963

(Thousand dollars)

Region	Total		Retail Trade	
	Value added	Value added attributed to timber	Value added	Value added attributed to timber
		1972		
North:				
Northeast	42,387,000	1,759,000	22,775,000	808,000
North Central	44,982,000	1,604,000	24,911,000	955,000
Total	87,369,000	3,363,000	47,666,000	1,763,000
South:				
Southeast	23,158,000	1,022,000	13,984,000	612,000
South Central	21,448,000	841,000	12,059,000	502,000
Total	44,606,000	1,863,000	26,043,000	1,114,000
West:				
Mountain	6,501,000	282,000	4,051,000	185,000
Pacific	23,625,000	1,050,000	13,875,000	499,000
Total	30,126,000	1,332,000	17,926,000	684,000
Total, United States	162,101,000	6,558,000	91,635,000	3,561,000
		1967		
North:				
Northeast	28,979,000	1,363,000	15,830,000	753,000
North Central	30,731,000	1,194,000	17,866,000	828,000
Total	59,710,000	2,557,000	33,696,000	1,581,000
South:				
Southeast	13,571,000	595,000	8,334,000	376,000
South Central	13,025,000	529,000	7,730,000	366,000
Total	26,596,000	1,124,000	16,064,000	742,000
West:				
Mountain	3,729,000	144,000	2,423,000	105,000
Pacific	15,626,000	749,000	9,441,000	385,000
Total	19,355,000	893,000	11,864,000	490,000
Total, United States	105,661,000	4,574,000	61,624,000	2,813,000
		1963		
North:				
Northeast	22,375,000	1,123,000	12,136,000	559,000
North Central	22,782,000	954,000	13,099,000	632,000
Total	45,157,000	2,007,000	25,235,000	1,191,000

Table A-38.—Estimated employment and employment attributed to timber in transportation and m in the United States, by region and State, 1972, 1967, and 1963

(Number)

egion and State	1972						1967			
	Total		Transportation		Marketing		Total		Transportation	
	Employment	Employment attributed to timber	Employment	Employment attributed to timber	Employment	Employment attributed to timber	Employment	Employment attributed to timber	Employment	Emplo attrib to ti
orth:										
Northeast:										
Maine	84,300	3,950	7,500	950	76,800	3,000	71,400	3,450	6,800	
New Hampshire	64,850	3,400	3,450	500	61,400	2,900	50,750	2,550	2,850	
Vermont	37,750	2,100	2,900	[1]	34,850	1,700	31,050	1,650	2,500	
Massachusetts	704,850	33,000	39,050	5,450	665,800	27,550	491,350	26,400	38,200	
Rhode Island	80,400	4,100	5,800	800	74,600	3,300	73,800	4,050	5,600	
Connecticut	267,800	13,200	17,550	2,400	250,250	10,800	234,100	12,600	17,300	
New York	1,634,650	70,600	146,000	10,600	1,488,650	60,000	1,671,850	96,200	182,400	
New Jersey	680,850	27,250	87,100	5,750	593,750	21,500	597,850	32,100	81,450	
Pennsylvania	1,037,500	41,800	126,450	8,800	911,050	33,000	977,300	51,400	127,750	
Total	4,592,950	199,400	435,800	35,650	4,157,150	163,750	4,199,450	230,400	464,850	
North Central:										
Ohio	963,150	35,150	116,650	6,100	846,500	29,050	858,000	39,500	109,100	
Indiana	466,900	17,700	50,450	2,650	416,450	15,050	420,050	18,950	47,850	
Illinois	1,107,950	42,350	127,900	7,150	980,050	35,200	1,060,750	46,150	136,600	
Michigan	718,000	26,850	60,300	3,000	657,700	23,850	659,150	29,700	60,450	
Wisconsin	400,400	17,550	36,900	3,250	363,500	14,300	354,500	17,900	32,750	
Minnesota	377,500	18,550	41,250	4,300	336,250	14,250	328,800	17,600	36,250	
Iowa	268,150	10,600	26,850	2,100	241,300	8,500	244,300	11,100	22,450	
Missouri	461,550	18,650	56,000	4,550	405,550	14,100	429,500	20,550	53,900	
North Dakota	56,500	2,700	5,750	700	50,750	2,000	52,050	2,550	5,550	
South Dakota	58,200	2,200	5,200	[1]	53,000	1,800	51,750	2,200	3,700	
Nebraska	159,300	7,500	22,400	2,400	136,900	5,100	141,650	7,050	19,450	
Kansas	213,700	9,650	29,600	3,150	184,000	6,500	193,350	9,400	28,500	
Total	5,251,300	209,450	579,250	39,750	4,672,050	169,700	4,793,850	222,650	556,500	
Total, North	9,844,250	408,850	1,015,050	75,400	8,829,200	333,450	8,993,300	453,050	1,021,350	
uth:										
Southeast:										
Delaware	55,250	2,200	5,250	[1]	50,000	1,850	46,800	2,300	5,300	
Maryland	425,550	16,350	43,350	3,050	382,200	13,300	387,000	27,950	48,400	
Virginia	390,300	25,500	45,950	5,350	344,350	20,150	324,550	9,800	43,300	
West Virginia	128,450	6,300	18,500	2,150	109,950	4,150	119,300	18,150	19,300	
North Carolina	428,950	22,800	48,200	4,700	380,750	18,100	359,350	10,400	40,500	
South Carolina	191,700	10,050	17,850	1,900	173,850	8,150	156,700	16,200	13,600	
Georgia	429,750	23,150	45,050	4,950	384,700	18,200	353,250	25,150	38,750	
Florida	722,150	32,100	51,650	5,450	670,500	26,650	536,550	7,650	38,350	
Total	2,772,100	138,450	275,800	27,900	2,496,300	110,550	2,283,500	117,600	247,550	
South Central:										
Kentucky	248,600	12,150	31,400	3,900	217,200	8,250	217,250	11,900	28,900	
Tennessee	352,900	17,250	40,200	4,300	312,700	12,950	298,550	15,950	33,800	
Alabama	257,700	14,100	27,800	3,100	229,900	11,000	224,500	12,050	24,750	
Mississippi	149,950	7,600	14,750	1,600	135,200	6,000	126,700	6,750	11,700	
Arkansas	149,650	7,400	17,500	1,800	132,150	5,600	133,000	6,300	16,100	
Louisiana	314,500	14,950	48,700	4,850	265,800	10,100	281,700	15,150	48,400	
Oklahoma	221,200	9,900	19,550	1,650	201,650	8,250	193,650	8,950	15,700	
Texas	1,113,650	49,000	112,750	10,750	1,000,900	38,250	937,150	44,700	109,600	
Total	2,808,150	132,350	312,650	31,950	2,495,500	100,400	2,412,550	121,750	288,950	
Total, South	5,580,250	270,800	588,450	59,850	4,991,800	210,950	4,696,050	239,350	536,500	
est:										
Mountain:										
Montana	67,550	3,750	9,850	1,200	57,700	2,550	59,250	2,900	9,550	
Idaho	70,050	3,750	7,250	750	62,800	3,000	59,100	2,600	6,250	
Wyoming	33,950	1,750	5,900	700	28,050	1,050	29,150	1,550	5,700	
Colorado	232,050	11,500	18,700	1,600	213,350	9,900	179,950	8,350	17,750	
New Mexico	86,500	4,150	7,050	700	79,450	3,450	71,750	3,400	7,500	

Table A-38.—Estimated employment and employment attributed to timber in transportation and marketi in the United States, by region and State, 1972, 1967, and 1963 — Continued

(Number)

Region and State	1963					
	Total		Transportation		Marketing	
	Employment	Employment attributed to timber	Employment	Employment attributed to timber	Employment	Employment attributed to timber
North:						
Northeast:						
Maine	69,850	4,000	8,050	1,550	61,800	2,450
New Hampshire	44,800	2,550	2,800	[1]	42,000	2,100
Vermont	27,750	1,600	3,000	600	24,750	1,000
Massachusetts	449,050	27,200	39,400	6,900	409,650	20,300
Rhode Island	66,650	4,000	5,550	950	61,100	3,050
Connecticut	207,500	12,300	17,100	3,100	190,400	9,200
New York	1,613,550	92,400	193,300	20,800	1,420,250	71,600
New Jersey	544,250	28,700	75,900	6,550	468,350	22,150
Pennsylvania	924,600	47,000	137,300	11,600	787,300	35,400
Total	3,948,000	219,750	482,400	52,500	3,465,600	167,250
North Central:						
Ohio	789,150	37,300	112,100	6,800	677,050	30,500
Indiana	379,200	17,950	48,050	2,600	331,150	15,350
Illinois	978,800	45,350	144,800	8,450	834,000	36,900
Michigan	585,600	26,050	57,000	3,600	528,600	22,450
Wisconsin	321,600	18,000	32,200	4,400	289,400	13,600
Minnesota	298,550	19,200	37,100	6,300	261,450	12,900
Iowa	223,800	11,800	23,000	3,500	200,800	8,300
Missouri	400,950	19,300	54,400	4,100	346,550	15,200
North Dakota	49,600	3,150	6,250	1,200	43,350	1,950
South Dakota	49,900	2,700	4,050	550	45,850	2,150
Nebraska	134,150	7,550	21,800	2,450	112,350	5,100
Kansas	177,650	9,000	29,450	3,250	148,200	5,750
Total	4,388,950	217,350	570,200	47,200	3,818,750	170,150
Total, North	8,336,950	437,100	1,052,600	99,700	7,284,350	337,400
South:						
Southeast:						
Delaware	42,000	2,200	5,550	450	36,450	1,750
Maryland	518,250	24,750	42,700	3,800	475,550	20,950
Virginia	140,650	7,800	44,950	3,550	95,700	4,250
West Virginia	301,000	14,800	20,350	1,300	280,650	13,500
North Carolina	156,800	9,600	34,200	4,000	122,600	5,600
South Carolina	278,350	13,950	12,400	1,600	265,950	12,350
Georgia	442,650	20,550	37,200	4,700	405,450	15,850
Florida	117,500	8,300	33,800	4,500	83,700	3,800
Total	1,997,200	101,950	231,150	23,900	1,766,050	78,050
South Central:						
Kentucky	201,950	11,750	29,450	4,050	172,500	7,700
Tennessee	262,850	14,950	31,700	4,000	231,150	10,950
Alabama	204,150	11,700	25,850	3,350	178,300	8,350
Mississippi	113,600	6,350	11,550	1,550	102,050	4,800
Arkansas	118,050	6,000	15,350	1,150	102,700	4,850
Louisiana	237,450	13,900	44,850	5,500	192,600	8,400
Oklahoma	171,050	8,500	15,300	1,000	155,750	7,500
Texas	827,050	40,700	102,300	9,200	724,750	31,500
Total	2,136,150	113,850	276,350	29,800	1,859,800	84,050
Total, South	4,133,350	215,800	507,500	53,700	3,625,850	162,100
West:						
Mountain:						
Montana	57,600	3,900	10,100	1,900	47,500	2,000
Idaho	56,500	2,800	7,700	850	48,800	1,950
Wyoming	30,650	1,650	6,600	750	24,050	900
Colorado	165,500	8,750	19,500	1,850	146,000	6,900

Table A-39—Estimated employment and employment attributed to timber in transportation in the Un by industry and region, 1972, 1967, and 1963

(Number)

Region	Total		Railroad		Truck	
	Employment	Employment attributed to timber	Employment	Employment attributed to timber	Employment	Employment attributed to timber
			1972			
North:						
Northeast	435,800	35,650	96,400	8,450	274,900	20,500
North Central	579,250	39,750	210,300	25,600	347,900	12,000
Total	1,015,050	75,400	306,700	34,050	622,800	32,550
South:						
Southeast	275,800	27,900	75,950	11,550	169,300	13,200
South Central	312,650	31,950	84,700	14,150	174,100	12,300
Total	588,450	59,850	160,650	25,700	343,400	25,500
West:						
Mountain	75,350	7,700	32,650	5,400	42,450	2,250
Pacific	220,100	22,500	56,000	9,500	129,800	9,500
Total	295,450	165,450	88,650	14,900	172,250	11,750
Total, United States	1,898,950	165,450	556,000	74,650	1,138,450	69,800
			1967			
North:						
Northeast	464,850	49,900	118,950	9,650	248,900	29,250
North Central	556,500	39,450	237,800	26,700	299,400	10,550
Total	1,021,350	89,350	356,750	36,350	548,300	39,800
South:						
Southeast	247,550	27,100	86,650	11,450	134,250	12,650
South Central	288,950	29,450	88,550	13,700	140,650	8,950
Total	536,500	56,550	175,200	25,150	274,900	21,600
West:						
Mountain	71,700	7,350	38,750	6,050	32,850	1,300
Pacific	219,400	24,100	64,250	10,050	111,350	9,100
Total	291,100	31,450	103,000	16,100	144,200	10,400
Total, United States	1,848,950	177,350	634,950	77,600	967,400	71,800
			1963			
North:						
Northeast	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table A-40—Estimated employment and employment attributed to timber in marketing in t by industry and region, 1972, 1967, and 1963

(Number)

Region	Total		Retail Trade	
	Employment	Employment attributed to timber	Employment	Employment attributed to timber
			1972	
North:				
Northeast	4,157,150	163,750	2,945,000	104,850
North Central	4,672,050	169,700	3,510,150	134,750
Total	8,829,200	333,450	6,455,150	239,600
South:				
Southeast	2,496,300	110,550	1,907,900	83,950
South Central	2,495,500	100,400	1,850,500	77,350
Total	4,991,800	210,950	3,758,400	161,300
West:				
Mountain	743,900	32,950	580,900	26,450
Pacific	2,243,000	92,350	1,703,400	61,300
Total	2,986,900	125,300	2,284,300	87,750
Total, United States	16,807,900	669,700	12,497,850	488,650
			1967	
North:				
Northeast	3,734,650	180,000	2,711,900	133,200
North Central	4,237,300	182,450	3,202,000	153,150
Total	7,971,950	362,450	5,913,900	286,350
South:				
Southeast	2,035,950	91,250	1,562,150	71,450
South Central	2,123,600	93,050	1,616,950	77,350
Total	4,159,550	184,300	3,179,100	148,800
West:				
Mountain	572,500	23,100	450,000	19,500
Pacific	1,942,350	87,900	1,462,100	59,300
Total	2,514,850	111,000	1,912,100	78,800
Total, United States	14,646,350	657,750	11,005,100	513,950
			1963	
North:				
Northeast	3,465,600	167,250	2,558,850	117,900
North Central	3,818,750	170,150	2,904,100	140,100
Total	7,284,350	337,400	5,462,950	258,000
South:				
Southeast	1,766,050	78,050	1,354,100	60,650
South Central	1,859,800	84,050	1,405,950	68,200

1—Estimated value added in timber-based economic activities in the United States, by industry and region, 1972, 1967

(Thousand dollars)

	Total	Timber management	Harvesting	Primary manufacturing	Secondary manufacturing	Construction
				1972		
	9,311,700	66,050	118,000	1,108,650	3,224,350	2,533,650
	10,074,800	112,850	172,850	1,176,950	3,217,400	2,968,750
	19,386,500	178,900	290,850	2,285,600	6,441,750	5,502,400
	8,978,300	406,950	461,800	1,693,100	2,770,800	2,208,650
	7,820,400	554,150	639,200	1,910,300	1,766,150	1,604,600
	16,798,700	961,100	1,101,000	3,603,400	4,536,950	3,813,250
	2,148,250	175,100	239,000	313,350	167,200	831,600
	10,131,000	1,548,600	1,434,500	2,594,600	1,358,300	1,800,000
	12,279,250	1,723,700	1,673,500	2,907,950	1,525,500	2,631,600
es	48,464,450	2,863,700	3,065,350	8,796,950	12,504,200	11,947,250
				1967		
	7,491,950	52,900	113,550	942,650	2,650,300	1,973,550
	6,858,300	89,200	142,850	937,650	2,252,300	1,715,300
	14,350,250	142,100	256,400	1,880,300	4,902,600	3,688,850
	5,313,850	249,850	331,200	1,148,850	1,768,500	966,450
	4,531,400	276,800	341,750	1,082,100	1,141,150	834,600
	9,845,250	526,650	672,950	2,230,950	2,909,650	1,801,050
	971,200	79,800	146,250	181,000	73,100	256,050
	5,601,650	721,150	686,300	1,336,450	880,900	986,850
	6,572,850	800,950	832,550	1,517,450	954,000	1,242,900
es	30,768,350	1,469,700	1,761,900	5,628,700	8,766,250	6,732,800
				1963		
	6,337,300	52,500	102,500	793,400	2,150,450	1,644,450
	5,827,400	77,750	138,550	780,100	1,684,400	1,665,600
	12,164,700	130,250	241,050	1,573,500	3,834,850	3,310,050

Table A-42—Estimated value added in timber-based economic activities in the United States, by region and

(Thousand dollars)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	510,150	385,300	307,750
New Hampshire	232,850	161,050	115,550
Vermont	131,400	94,100	72,350
Massachusetts	1,134,050	849,600	763,200
Rhode Island	146,200	106,800	89,500
Connecticut	512,100	374,800	314,000
New York	3,157,200	2,946,850	2,459,850
New Jersey	1,352,550	999,500	865,100
Pennsylvania	2,135,200	1,573,950	1,350,000
Total	9,311,700	7,491,950	6,337,300
North Central:			
Ohio	1,756,550	1,263,750	1,033,150
Indiana	960,000	650,450	508,900
Illinois	2,006,000	1,270,900	1,148,950
Michigan	1,439,200	1,042,800	837,850
Wisconsin	1,296,200	960,100	768,650
Minnesota	837,550	518,650	478,950
Iowa	358,050	245,950	211,450
Missouri	806,300	546,300	462,150
North Dakota	52,150	30,800	43,250
South Dakota	58,450	34,550	43,600
Nebraska	213,850	122,900	120,050
Kansas	290,400	171,150	170,450
Total	10,074,800	6,858,300	5,827,400
Total, North	19,386,500	14,350,250	12,164,700
South:			
Southeast:			
Delaware	95,050	63,650	61,200
Maryland	754,000	499,850	383,850
Virginia	1,406,250	877,200	683,750
West Virginia	274,650	192,250	158,050
North Carolina	1,845,050	1,219,850	886,250
South Carolina	1,032,800	602,250	470,150
Georgia	1,839,250	1,010,400	830,900
Florida	1,731,250	848,400	605,350
Total	8,978,300	5,313,850	4,079,500

Region and State	1972
South Central:	
Kentucky	505,45
Tennessee	983,60
Alabama	1,220,70
Mississippi	830,95
Arkansas	846,95
Louisiana	1,080,35
Oklahoma	337,45
Texas	2,014,95
Total	7,820,40
Total, South	16,798,70
West:	
Mountain:	
Montana	325,95
Idaho	425,45
Wyoming	65,90
Colorado	443,25
New Mexico	115,50
Arizona	455,45
Utah	162,05
Nevada	114,70
Total	2,148,25
Pacific:	
Washington	2,307,65
Oregon	2,993,20
California	4,548,30
Alaska	126,05
Hawaii	155,80
Total	10,131,00
Total, West	12,279,25
Total, United States	48,464,45

Sources: See source notes to individual subject tables.

Table A-43—Estimated employment in timber-based economic activities in the United States, by industry and region

(Number)

Region	Total	Timber management	Harvesting	Primary manufacturing	Secondary manufacturing	Con
			1972			
North:						
Northeast	675,250	12,400	19,350	59,850	232,600	1
North Central	700,100	15,300	25,900	61,800	200,650	1
Total	1,375,350	27,700	45,250	121,650	433,250	3
South:						
Southeast	688,500	25,300	40,300	85,150	224,600	1
South Central	585,150	23,400	57,200	96,400	142,950	1
Total	1,273,650	48,700	97,500	181,550	367,550	3
West:						
Mountain	143,450	11,650	8,350	16,950	13,650	
Pacific	472,500	29,150	39,300	106,400	85,950	
Total	615,950	40,800	47,650	123,350	99,600	1
Total, United States	3,264,950	117,200	190,400	426,550	900,400	7
			1967			
North:						
Northeast	737,700	11,300	28,700	68,700	256,250	1
North Central	677,200	14,250	34,200	66,550	193,900	1
Total	1,414,900	25,550	62,900	135,250	450,150	2
South:						
Southeast	558,800	22,700	54,300	87,100	196,850	
South Central	516,600	21,500	63,800	94,050	122,100	
Total	1,075,400	44,200	118,100	181,150	318,950	1
West:						
Mountain	99,950	10,850	10,200	17,600	7,800	
Pacific	433,450	27,050	45,150	103,750	74,050	
Total	533,400	37,900	55,350	121,350	81,850	
Total, United States	3,023,700	107,650	236,350	437,750	850,950	5
			1963			
North:						
Northeast	747,850	10,250	32,700	70,550	256,600	1
North Central	684,000	13,000	40,800	64,850	178,100	1
Total	1,431,850	23,250	73,500	135,400	434,700	3
South:						

Table A-44—Estimated employment in timber-based economic activities in the United States, by region and S

(Number)

Region and State	1972	1967	1963
North:			
Northeast:			
Maine	40,200	42,200	38,850
New Hampshire	19,500	17,100	16,800
Vermont	12.050	11,350	11,100
Massachusetts	90,100	89,600	93,950
Rhode Island	11,800	12,550	12,150
Connecticut	37,100	37,150	38,750
New York	213,050	255,100	271,150
New Jersey	89,750	95,900	95,500
Pennsylvania	161,700	176,750	169,600
Total	675,250	737,700	747,850
North Central:			
Ohio	118,150	116,250	113,450
Indiana	69,950	67,950	64,250
Illinois	130,750	125,000	127,550
Michigan	97,650	100,800	95,350
Wisconsin	86,350	86,900	86,050
Minnesota	57,450	49,050	56,850
Iowa	28,050	27,350	27,750
Missouri	61,500	60,500	61,850
North Dakota	4,650	4,200	6,100
South Dakota	5,800	5,300	6,700
Nebraska	16,850	14,150	16,350
Kansas	22,950	19,750	21,750
Total	700,100	677,200	684,000
Total, North	1,375,350	1,414,900	1,431,850
South:			
Southeast:			
Delaware	6,800	6,700	6,500
Maryland	53,100	61,500	55,400
Virginia	110,800	81,150	82,550
West Virginia	21,900	35,550	33,450
North Carolina	159,750	135,100	123,150
South Carolina	77,850	74,850	69,950
Georgia	126,250	113,300	113,700
Florida	132,250	50,650	66,900
Total	688,500	558,800	551,600

Region and State	1972
South Central:	
Kentucky	41,350
Tennessee	81,750
Alabama	84,700
Mississippi	61,950
Arkansas	58,700
Louisiana	66,600
Oklahoma	28,800
Texas	161,300
Total	585,150
Total, South	1,273,650
West:	
Mountain:	
Montana	17,200
Idaho	21,800
Wyoming	4,250
Colorado	35,900
New Mexico	13,000
Arizona	29,400
Utah	14,250
Nevada	7,650
Total	143,450
Pacific:	
Washington	92,500
Oregon	103,750
California	259,550
Alaska	6,650
Hawaii	10,050
Total	472,500
Total, West	615,950
Total, United States	3,264,950

Sources: See source notes to individual subject tables.

Appendix B:
Industry Definitions

Most of the data on primary and secondary manufacturing used in this study came from the 1963, 1967, and 1972 *Censuses of Manufactures*. Firms are classified for the manufacturing census basically according to the products they produce. Thus, an establishment is classified in a particular industry (SIC) if its production of the primary products of that industry exceeds in value its production of products of any other single industry. While some establishments produce only the primary products of the industry in which they are classified, rarely do all the establishments in an industry specialize to that extent. For example, only 94 percent of the total value of shipments from those firms classified in the Wood Household Furniture Industry (SIC 2511) in 1972, was wood household furniture. The remaining 6 percent consisted of such diverse products as metal office and household furniture, hardwood dimension and flooring, games, toys, sporting and athletic goods, and household cooking equipment. Looked at from the product viewpoint, about 95 percent of the total value of shipments of wood household furniture in 1972 came from firms classified in the Wood Household Furniture Industry. In addition, wood household furniture was produced in the Upholstered and Metal Furniture Industries (SIC's 2512 and 2514), the Mattresses and Bedsprings Industry (SIC 2515), and in several others.

The types of firms (by SIC industry codes) included in the major primary and secondary manufacturing industries recognized in this study are shown in table B-1 on page 83 and defined below. Changes necessitated by SIC industry reclassification during the study period are shown in the footnotes to table B-1 and discussed below.

Primary Manufacturing

Sawmills and planing mills:

2421 *Sawmills and Planing Mills, General*—Establishments primarily engaged in sawing rough lumber and timber from logs and bolts or resawing cants and flitches into lumber, including box lumber and softwood cut stock; planing mills

frames for household furn
primarily engaged in manuf
for household furniture, a
1972, were classified in in
stered Household Furniture

Veneer and plywood plants:

2432 *Veneer and Plywood*—Esta
engaged in producing com
face or technical, and those
manufacturing commercial
nonwood backed or faced
faced plywood, from veneer
establishment or from purch
1963 only).

2435 *Hardwood Veneer and Plyw*
primarily engaged in produc
wood veneer, either face or
primarily engaged in manu
plywood or prefinished har
includes nonwood backed
nonwood faced plywood fro
the same establishment or fr
This SIC was created in 19
2432, Veneer and Plywood,
hardwood and softwood ind

2436 *Softwood Veneer and Plyw*
primarily engaged in produc
wood veneer and plywood, f
in the same establishment
veneer. This SIC was created
SIC 2432, Veneer and Ply
separate hardwood and soft

Pulp, paper, and paperboard mills

2611 *Pulpmills*—Establishments
manufacturing pulp from
materials such as rags,
bagasse, and straw.

board mills and not separately reported are also included.

2661 *Building Paper and Board Mills*—Establishments primarily engaged in manufacturing building paper and building board from wood pulp and other fibrous materials. Pulpmills combined with building paper and building board mills, and not separately reported, are also included.

Other primary:

2429 *Special Product Sawmills, N.E.C.*—Establishments primarily engaged in manufacturing excelsior, wood shingles, and cooperage stock; and in sawing special products, not elsewhere classified.

2492 *Particleboard*—Establishments primarily engaged in manufacturing wood panel products from small wood particles. Manufacture may take place in hydraulic presses with heated platens or by extrusion. This SIC was created in 1972. Establishments classified in this SIC were formerly part of 2499, Wood Products, N.E.C.

2861 *Gum and Wood Chemicals*—Establishments primarily engaged in manufacturing hardwood and softwood distillation products, wood and gum naval stores, charcoal, natural dyestuffs, and natural tanning materials.

Secondary Manufacturing

Millwork and prefabricated wood products:

2431 *Millwork*—Establishments primarily engaged in manufacturing fabricated millwork. Planing mills primarily engaged in producing millwork are included, but planing mills primarily producing standard workings or patterns of lumber are classified in SIC 2421, Sawmills and Planing Mills, General. In 1967 and 1963, this SIC also included the manufacture of custom cabinetwork to be built-in, which was transferred to new SIC 2434, Wood Kitchen Cabinets, in 1972.

2433 *Prefabricated Wood Structures*—Establishments

2439 *Structural Wood M*
ments primarily enga
or fabricated trusses,
members of lumber.
Establishments now
SIC 2433, Prefabrica
and 1963.

2451 *Mobile Homes*—Es
gaged in manufactu
mobile homes are ge
least 8 feet wide, do
of water or waste, ar
This SIC was created
classified in this SIC
Trailer Coaches.

2452 *Prefabricated Wood*
primarily engaged in
wood buildings, sect
was created in 1972.
in this SIC were for
cated Wood Structur

3791 *Trailer Coaches*—Es
gaged in manufactu
dwellings) for attach
pickup coaches (camp
trucks.

Wooden containers:

2441 *Nailed Wood Boxes*
primarily engaged in
lock-corner wooden
which also may pro
lock-corner boxes.

2442 *Wirebound Boxes a*
primarily engaged in
boxes and crates (196

2443 *Veneer and Plywood*
primarily engaged in
plywood containers,
baskets made primar

2449 *Wood Containers, N.E.C.*—Establishments primarily engaged in manufacturing wood containers, not elsewhere classified, such as cooperage, wirebound boxes and crates, and other veneer and plywood containers. This SIC was created in 1972 by combining former SIC's 2442, Wirebound Boxes and Crates; 2443, Veneer and Plywood Containers; and 2445, Cooperage.

Furniture:

2511 *Wood Household Furniture*—Establishments primarily engaged in manufacturing wood household furniture commonly used in dwellings. Also included are establishments engaged in manufacturing infants' and children's wood furniture and wood outdoor furniture. In 1967 and 1963, this SIC also included establishments primarily engaged in the manufacture of wood kitchen cabinets (transferred to SIC 2434 in 1972) and those primarily engaged in manufacturing wood, TV, radio, phonograph, and sewing machine cabinets (transferred to SIC 2517 in 1972.)

2512 *Upholstered Household Furniture*—Establishments primarily engaged in manufacturing upholstered furniture on wood frames. In 1963 and 1967, this SIC also included those firms primarily engaged in manufacturing only wood frames for upholstered furniture. In 1972 these establishments were included in SIC 2426.

2514 *Metal Household Furniture*—Establishments primarily engaged in manufacturing metal household furniture, whether padded or plain, of a type commonly used in dwellings.

2515 *Mattresses and Bedsprings*—Establishments primarily engaged in manufacturing innerspring mattresses, box spring mattresses, and noninnerspring mattresses containing felt, foam rubber, or any other filling material; and assembled wire springs (fabric, coil, or box) for use on beds, couches, and

2519 *Household Furniture, N.E*
primarily engaged in manufa
and other wicker furniture, p
household furniture and cab
furniture, N.E.C.

2521 *Wood Office Furniture*—Es
ily engaged in manufacturi
niture whether padded, upho

2531 *Public Building and Relate*
lishments primarily engaged i
niture for schools, theate
churches, and libraries, an
manufacture of seats for pu
seats for automobiles and ai

2541 *Wood Partitions and Fixt*
primarily engaged in manufa
ing, lockers, office and sto
ricated plastic laminated fixt
fabricated products.

2542 *Metal Partitions and Fixt*
primarily engaged in manufa
ing, storage racks, lockers,
tures, prefabricated parti
fabricated products.

2599 *Furniture and Fixtures, N.*
primarily engaged in manufa
fixtures, not elsewhere class
niture especially designed fo
bars, cafeterias, bowling
ships.

Paper and paperboard products:

2641 *Paper Coating and Gla*
primarily engaged in ma
glazed, or varnished paper f
Also included are estab

2645 *Die-cut Paper and Board*—Establishments primarily engaged in diecutting purchased paper and paperboard; and in manufacturing cardboard by laminating, lining, or surface coating paperboard.

2646 *Pressed and Molded Pulp Goods*—Establishments primarily engaged in manufacturing all kinds of pressed and molded goods, including papiermache articles other than statuary and art goods.

2647 *Sanitary Paper Products*—Establishments primarily engaged in manufacturing, from purchased paper, sanitary paper products, such as facial tissue and hankerchiefs, table napkins, toilet paper, towels, disposable diapers, and sanitary napkins and tampons. In 1967 and 1963, firms manufacturing disposable paper diapers were in 2399, Fabricated Textile Products, N.E.C.

2648 *Stationery Products*—Establishments primarily engaged in manufacturing stationery, tablets, looseleaf fillers, and related items from purchased paper. This SIC was created in 1972. Establishments now classified in this SIC were formerly in 2649, Converted Paper Products, N.E.C.

2649 *Converted Paper Products N.E.C.*—Establishments primarily engaged in manufacturing from purchased paper or paperboard, miscellaneous converted paper or paperboard products, not elsewhere classified. Includes firms manufacturing wallpaper in 1972, formally in 2644 in 1967 and 1963.

2651 *Folding Paperboard Boxes*—Establishments primarily engaged in manufacturing folding paperboard boxes from purchased paperboard.

2652 *Set-up Paperboard Boxes*—Establishments primarily engaged in manufacturing setup paperboard boxes from purchased paperboard.

2653 *Corrugated and Solid Fiber Boxes*—Establishments primarily engaged in manufacturing corrugated and solid fiber boxes and related products from purchased paperboard of fiber stock. Important products of this industry include corrugated and solid fiberboard boxes, pads, partitions,

from purchased
drums, and simila
metal ends, and vu

Fibers, plastics and textile

2211 *Weaving Mills, Co*
engaged in weavin
width, wholly or c

2221 *Weaving Mills, Ma*
ments primarily en
12 inches in width,
manmade fibers, in

2241 *Narrow Fabric M*
engaged in weaving
in width or narrow
manmade fibers, in

2253 *Knit Outerwear M*
engaged in knittin
manufacturing out
duced in the same

2254 *Knit Underwear M*
engaged in knittin
from yarn or in
nightwear from kni
establishment.

2256 *Knit Fabric Mill*
engaged in knitting
dyeing or finishing
only).

2258 *Warp Knit Fabric*
ily engaged in knitti
ing or finishing war

2259 *Knitting Mills, N.E*
engaged in knitting
elsewhere classified

2262 *Finishing Plants, M*
tablishments prima
chased manmade
fabrics or finishing
basis. These fin
bleaching, dyeing,

rowing and Winding Mills—Establishments marily engaged in texturizing, throwing, sting, winding, or spooling yarn wholly or efly by weight of cotton, manmade fibers, or k.

read Mills—Establishments primarily engaged manufacturing thread from natural or man- de fiber except flax and wool.

ocessed Textile Waste—Establishments marily engaged in processing textile mill waste spinning, padding, batting, or other uses; in overing textile fibers from clippings and rags; cutting flock from waste, recovered fibers, or v fiber stock, and in manufacturing oakum and sted jute packing.

e Cord and Fabric—Establishments primarily gaged in manufacturing cord and fabric for use reinforcing rubber tires, industrial belting, fuel s, and similar uses.

nwoven Fabric Mills—Establishments primarily gaged in manufacturing nonwoven fabrics (by nding and/or interlocking of fibers) by mechan- l, chemical, thermal, or solvent means or by nbinations thereof; or in manufacturing non- ven fabricated products such as blankets, rib- ns, and wipers (1972 only).

rdage and Twine—Establishments primarily gaged in manufacturing rope, cable, cordage, ne, and related products from abaca (Manila), l, henequen, hemp, cotton, paper, jute, flax, nmade fibers including glass, and other fibers.

n's and Boys' Suits and Coats—Establishments marily engaged in the manufacture of men's, ths', and boys' suits, coats, and overcoats. ablishments primarily engaged in manufactur- uniforms (except athletic) are also included in industry.

n's and Boys' Shirts and NightwearEstab- ments primarily engaged in the manufacture of ns' and boys' shirts (including polo and sports rts) and nightwear cut and sewed from pur- sed woven or knit fabrics.

women's, misses' and juniors' blous and shirts.

2335 *Women's and Misses' Dresses*—Esta primarily engaged in manufacturing misses' and juniors' dresses, including dresses and pants dresses, whether s piece or by the dozen.

2337 *Women's and Misses' Suits and Coats*— ments primarily engaged in man women's, misses', and juniors' suits, skirts, and coats except fur coats and These garments are generally tailored a lined.

2341 *Women's and Children's Underwear*— ments primarily engaged in manu women's, misses', children's, and underwear and nightwear cut and sewed chased woven or knit fabric.

2361 *Children's Dresses and Blouses*—Esta primarily engaged in manufacturi children's, and infants' dresses, blous and shirts, cut and sewed from purcha or knit fabric.

2363 *Children's Coats and Suits*—Establish marily engaged in manufacturing g dren's, and infants' coats and suits, cut from purchased woven or knit fabric.

2369 *Children's Outerwear, N.E.C.*—Esta primarily engaged in manufacturing g dren's, and infants' outerwear not elsew sified, cut and sewed from woven or kn

2384 *Robes and Dressing Gowns*—Establish marily engaged in manufacturing m women's robes and dressing gowns.

2391 *Curtains and Draperies*—Establishmen ily engaged in manufacturing cur draperies from purchased materials.

2392 *House Furnishings, N.E.C.*—Estab primarily engaged in manufacturing h nishings such as blankets, bedspread tablecloths, and towels from purchased

2394 *Canvas and Related Products*—Esta

cellulose such as rayon, by the viscose or cuprammonium process) in the form of monofilament, yarn, staple, or tow suitable for further manufacturing on spindles, looms, knitting machines, or other textile processing equipment.

Other secondary:

2491 *Wood Preserving*—Establishments primarily engaged in treating wood, sawed or planed in other establishments, with creosote or other preservatives to prevent decay and to protect against fire and insects. Also included is the cutting, treating, and selling of poles, posts, and piling, but establishments primarily engaged in manufacturing other wood products (which they may also treat with preservatives) are not included.

2499 *Wood Products N.E.C.*—Establishments primarily engaged in turning and shaping wood and

manufacturing mis
tan, reed, splint,
wicker, and willow
ments manufacturi
cork products, ha
mirror and picture
SIC also included
gaged in manufactu
Others—In additio
on employment an
timber included the
attributed to timber
and boats, small ar
and athletic goods
other items in whi
and timber product
tions of total value
were not made for
industries since the
turing industries no

Table B-1—Types of firms included in the major primary and secondary industries, 1972, 1967, an

Industry	1972	1967	1963
Primary manufacturing			
Sawmills and planing mills			
Sawmills and planing mills, general *(SIC 2421)*	X	X	X
Hardwood dimension and flooring *(SIC 2426)*	X[1]	X	X
Veneer and plywood plants			
Veneer and plywood plants *(SIC 2432)*	[2]	X	X
Hardwood veneer and plywood plants *(SIC 2435)*	X[2]		
Softwood veneer and plywood plants *(SIC 2436)*	X[2]		
Pulp, paper, and paperboard mills			
Pulp mills *(SIC 2611)*	X	X	X
Papermills except building paper *(SIC 2621)*	X	X	X
Paperboard mills *(SIC 2631)*	X	X	X
Building paper and board mills *(SIC 2661)*	X	X	X
Other primary			
Special product sawmills, n.e.c. *(SIC 2429)*	X	X	X
Particleboard *(SIC 2492)*	X	X	X
Gum and wood chemicals *(SIC 2861)*	X[3]		
Secondary manufacturing			
Millwork, and prefabricated wood products			
Millwork *(SIC 2431)*	X[4]		
Prefabricated wood structures *(SIC 2433)*	[5]	X	X
Wood kitchen cabinets *(SIC 2434)*	X[4]		
Structural wood members, n.e.c. *(SIC 2439)*	X[5]		
Mobile homes *(SIC 2451)*	X[6]		
Prefabricated wood buildings *(SIC 2452)*	X[5]		
Trailer coaches *(SIC 3791)*	[6]	X	X
Wooden containers			
Nailed wood boxes and shook *(SIC 2441)*	X	X	X
Wirebound boxes and crates *(SIC 2442)*	[7]	X	X
Veneer and plywood containers *(SIC 2443)*	[7]	X	X
Cooperage *(SIC 2445)*	[7]	X	X
Wood pallets and skids *(SIC 2448)*	X[8]		
Wood containers, n.e.c. *(SIC 2449)*	X[7]		
Furniture			
Wood household furniture *(SIC 2511)*	X[4,9]	X	X
Upholstered household furniture *(SIC 2512)*	X[1]	X	X
Metal household furniture *(SIC 2514)*	X	X	X
Mattresses and bedsprings *(SIC 2515)*	X	X	X
Wood TV and radio cabinets *(SIC 2517)*	X[9]		
Household furniture, n.e.c. *(SIC 2519)*	X	X	X
Wood office furniture *(SIC 2521)*	X	X	X
Public building and related furniture *(SIC 2531)*	X	X	X
Wood partitions and fixtures *(SIC 2541)*	X	X	X
Metal partitions and fixtures *(SIC 2542)*	X	X	X
Furniture and fixtures, n.e.c. *(SIC 2599)*	X	X	X
Paper and paperboard products			

Industry
Paper and paperboard products (cont'd)
Bags, except textile bags *(SIC 2643)*
Wallpaper *(SIC 2644)*
Die-cut paper and board *(SIC 2645)*
Pressed and molded pulp goods *(SIC 2646)*
Sanitary paper products *(SIC 2647)*
Stationery products *(SIC 2648)*
Converted paper products, nec *(SIC 2649)*
Folding paperboard boxes *(SIC 2651)*
Set-up paperboard boxes *(SIC 2652)*
Corrugated and solid fiber boxes *(SIC 2653)*
Sanitary food containers *(SIC 2654)*
Fiber cans, drums and similar products *(SIC 2655)*
Fibers, plastics and textile products
Weaving mills, cotton *(SIC 2211)*
Weaving mills, synthetics *(SIC 2221)*
Narrow fabric mills *(SIC 2241)*
Knit outerwear mills *(SIC 2253)*
Knit underwear mills *(SIC 2254)*
Knit fabric mills *(SIC 2256)*
Warp knit fabric mills *(SIC 2258)*
Knitting mills, n.c.c. *(SIC 2259)*
Finishing plants, synthetics *(SIC 2262)*
Tufted carpets and rugs *(SIC 2272)*
Yarn mills, except wool *(SIC 2281)*
Throwing and winding mills *(SIC 2282)*
Thread mills *(SIC 2284)*
Processed textile waste *(SIC 2294)*
Tire cord and fabric *(SIC 2296)*
Nonwoven fabric mills *(SIC 2297)*
Cordage and twine *(SIC 2298)*
Men's and boy's suits and coats *(SIC 2311)*
Men's and boy's shirts and nightwear *(SIC 2321)*
Men's and boy's neckwear *(SIC 2323)*
Men's and boy's separate trousers *(SIC 2327)*
Men's and boy's clothing, n.e.c. *(SIC 2329)*
Women's, misses' blouses and waists *(SIC 2331)*
Women's, misses' dresses *(SIC 2335)*
Women's, misses' suits, skirts, coats *(SIC 2237)*
Women's and children's underwear *(SIC 2341)*
Children's dresses and blouses *(SIC 2361)*
Children's coats and suits *(SIC 2363)*
Children's outerwear, n.e.c. *(SIC 2369)*
Robes and dressing gowns *(SIC 2384)*
Curtains and draperies *(SIC 2391)*
House furnishings, n.e.c. *(SIC 2392)*
Canvas products *(SIC 2394)*
Fabricated textile products, n.e.c. *(SIC 2399)*
Plastics materials and resins *(SIC 2821)*
Cellulosic man-made fibers *(SIC 2823)*
Other secondary
Wood preserving *(SIC 2491)*

Appendix C

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Table CF-1. — Tentative list of mammals for Cedar Flats Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Zapus princeps	western jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Odocoileus h. columbianus*	black-tailed deer
	Cervus canadensis roosevelti	Roosevelt elk

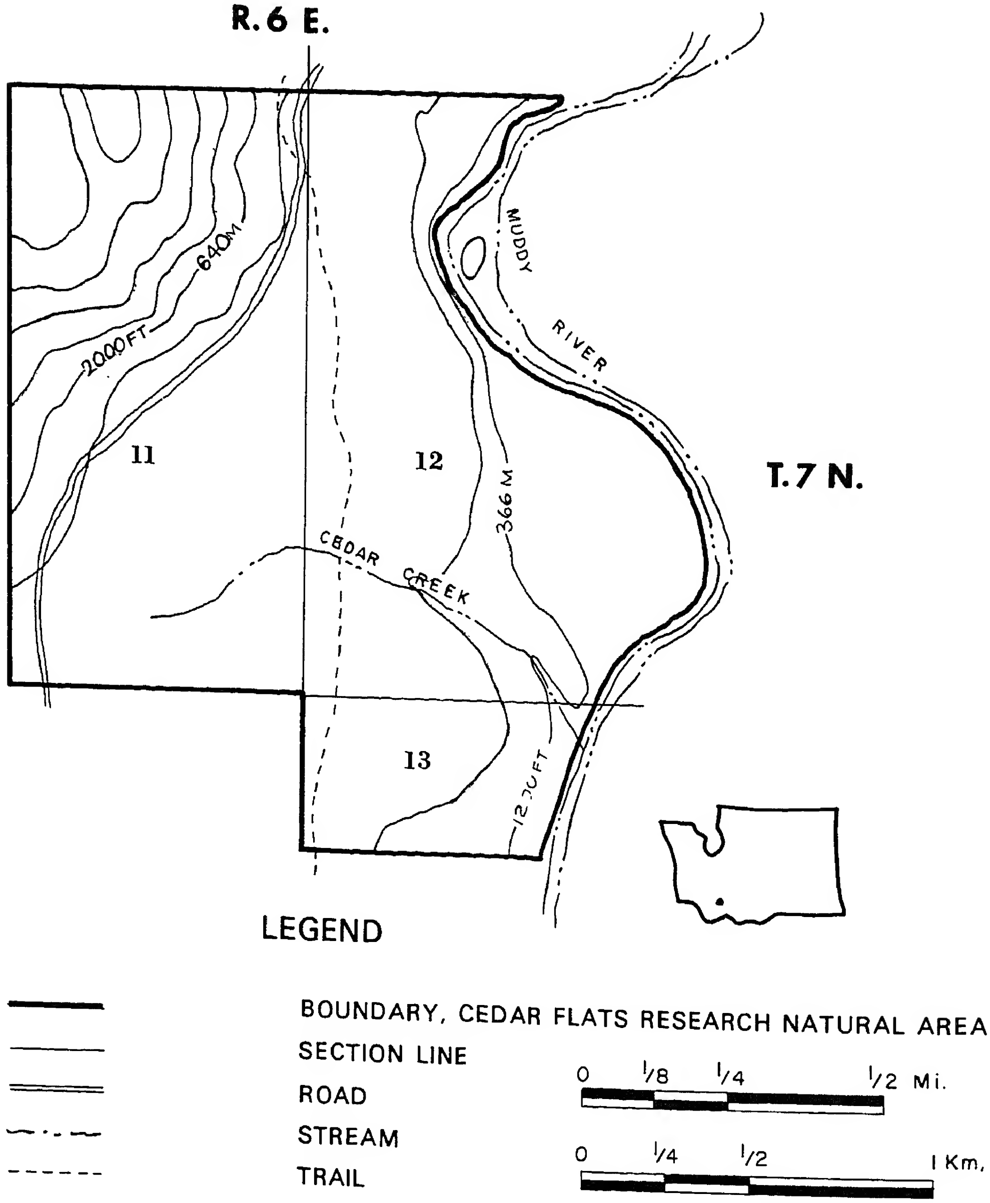


Figure CF-1.– Cedar Flats Research Natural Area, Skamania County, Washington.

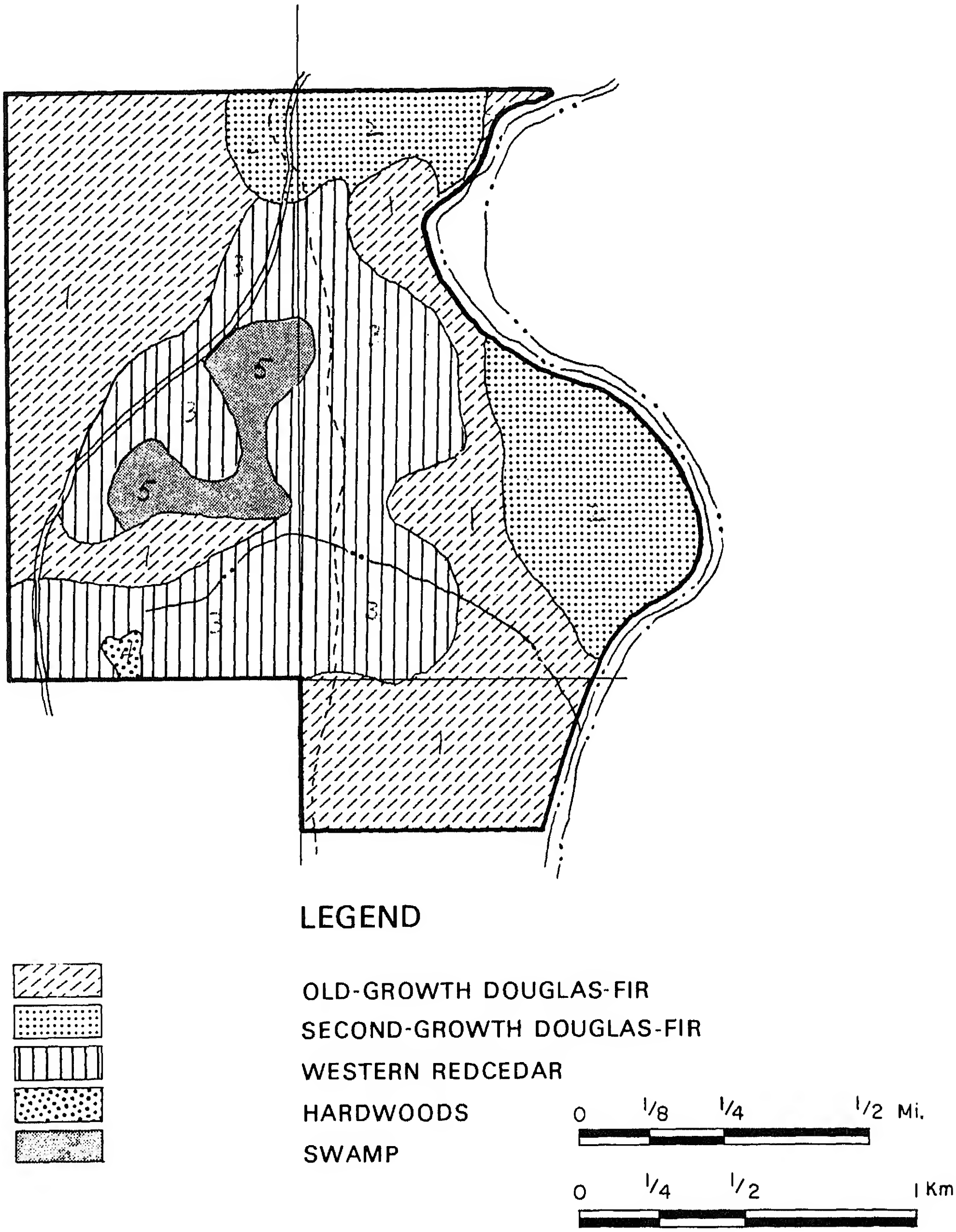
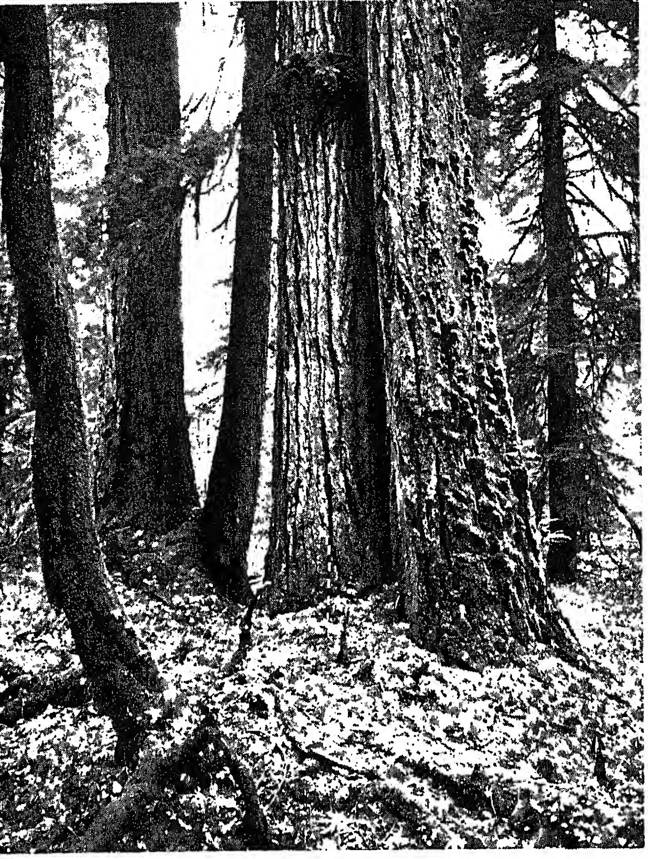
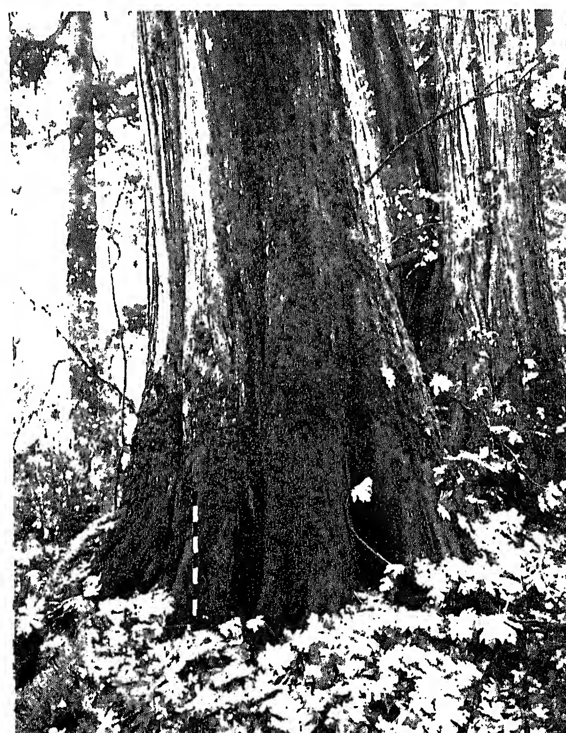


Figure CF-2.– **Vegetation types in the Cedar Flats Research Natural Area.**

Figure CF-3.—Communities of the Cedar Flats Research Natural Area. Upper left: Old-growth Douglas-fir and smaller associated western hemlock dominate a large portion of the natural area; bigleaf maple (left foreground) are scattered through both the upland and swamp habitats. Upper right: Grove of old-growth western redcedar showing typical understory dominants—*Acer circinatum* and *Polystichum munitum.* Lower left: Hardwoods, particularly red alder, are scattered through swampy areas, such as this one dominated by Cyperaceae. Lower right: Old-growth specimens of western redcedar attain diameters in excess of 250-cm. (100-in.) b.h.



Federal Research Natural Areas in Oregon and Washington—
A Guidebook for Scientists and Educators. 1972.
Pacific Northwest Forest and Range Experiment Station,
Portland, Oregon.

CHERRY CREEK RESEARCH NATURAL AREA[1]

Old-growth Douglas-fir and western hemlock stands growing on slopes and ridgetops in the southwestern Oregon Coast Ranges.

The Cherry Creek Research Natural Area was established on February 4, 1965. It typifies virgin, old-growth Douglas-fir (*Pseudotsuga menziesii*)-western hemlock (*Tsuga heterophylla*) stands as they occur on sedimentary materials in the southwestern Oregon Coast Ranges. The 239-ha. (590-acre) tract is located in Coos County, Oregon, and is administered by the Coos Bay District (Coos Bay, Oregon), Bureau of Land Management (BLM). The natural area occupies portions of sections 17, 18, 19, and 20, T. 27 S., R. 10 W., Willamette meridian (fig. CH-1). It lies at 45°13′ N. latitude and 123°56′ W. longitude.

ACCESS AND ACCOMMODATIONS

The normal approach to the natural area is from Coquille, to the south. Just west of the Coquille High School, turn north from State Highway 42 onto the Fairview-McKinley Road. At Fairview, 14.5 km. (9 miles) to the north, turn southeast (right) onto the Coos Bay Wagon Road. Follow this road to Cherry Creek Park (about 11 km. or 7 miles) and turn left on Cherry Creek County Road which later changes to the B.L.M. Cherry Creek Access Road (27-11-27.0). Follow it for 9.5 km. (6 miles) to the Big Tree Recreational Site at the edge of the natural area. The vicinity of the natural area can also be reached via the BLM Middle Creek Access Road (27-11-29.0) and Burnt Mountain Road (27-11-12.0). To approach the north side of the natural area in this way, turn onto the Middle Creek Access Road about 6 km. (4 miles) east of Fairview.

There are no roads or trails within the main body of the natural area. Access is by cross-country travel.

The nearest commercial accommodations are in Coquille and Coos Bay, approximately 35 km. (22 miles) and 50 km. (31 miles) away, respectively. There are several improved forest camps in the vicinity, the most convenient being located on Middle Creek.

ENVIRONMENT

The Cherry Creek Research Natural Area occupies complex ridge and valley topography bounding a portion of Cherry Creek. Slopes are generally moderate to steep on the middle and lower slopes and gentle to moderate along the ridgetops (fig. CH-1). Elevations range from about 207 m. (680 ft.) along Cherry Creek to 451 m. (1,480 ft.) in the northwestern corner of the natural area. The topography is very complex and dissected.

Sedimentary bedrock underlies the entire natural area. These sand and siltstones belong to the Tyee formation of Middle Eocene Age (Pech 1961).

The climate is wet and mild. Precipitation is seasonal, with a peak in January and December and a minimum in July and August. The summer drought period is more pronounced than in northern Oregon and Washington coastal mountains. The following climatic data are from the closest weather station at Sitkum located about 5 km. (3 miles) to the southeast (U.S. Weather Bureau 1965):

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

Mean annual temperature	11.1°C. (52.0°F.)
Mean January temperature	4.2°C. (40.6°F.)
Mean July temperature	17.2°C. (63.0°F.)
Mean January minimum temperature	0.8°C. (33.5°F.)
Mean July maximum temperature	25.1°C. (77.2°F.)
Average annual precipitation	2,035 mm. (80.11 in.)
June through August precipitation	82 mm. (3.21 in.)

A soil survey for the area is not available, but most soils tend toward relatively deep, Reddish-Brown Lateritics developed in colluvium and residuum from silt and sandstones. Surface (A1) horizons are typically dark brown in color and the B2 horizon has a clay-loam texture and fine to very fine, subangular, blocky structure. Depth to bedrock (R horizon) is typically from 100 to over 150 cm. (40 to 60 in.). A horizons typically average about 20 cm. (8 in.) in thickness and B horizons 75 to 90 cm. (30 to 35 in.).

BIOTA

All 239 ha. (590 acres) of the Cherry Creek Research Natural Area are classified as SAF cover type 230, Douglas-Fir — Western Hemlock (Society of American Foresters 1954). The area falls within Küchler's (1964) Type 2 (Cedar-Hemlock-Douglas Fir Forest) and the *Tsuga heterophylla* Zone of Franklin and Dyrness (1969).

Douglas-fir and western hemlock dominate the natural area. The average age of the Douglas-fir is not known, but it is believed to be in excess of 300 years. Old-growth Douglas-firs average 125- to 175-cm. (50- to 70-in.) d.b.h. The maximum recorded size is 294-cm. (116-in.) d.b.h. and 86.9 m. (285 ft.) high at over 600 years of age. Western hemlock typically average 75- to 100-cm. (30- to 40-in.) d.b.h. and are somewhat younger in age than associated Douglas-fir. Other tree species present on the natural area include western redcedar (*Thuja plicata*) and tanoak (*Lithocarpus densiflora*), with bigleaf maple (*Acer macrophyllum*) and California-laurel (*Umbellularia californica*) common in streamside areas (fig. CH-2).

The climax tree species on the natural area clearly appears to be western hemlock. Hemlock seedlings and saplings are more abundant than those of any other coniferous species. In some areas sprout and seedling reproduction of tanoak is also common, suggesting it may also be a climax species. Very little reproduction of Douglas-fir or western redcedar is present anywhere on the natural area.

Most of the forest communities on the natural area are assignable to one of the associations recognized by Bailey (1966) in a study of nearby old-growth forests. The communities on middle and lower slopes and on broad mesic ridgetops appear to belong to the *Tsuga heterophylla/Polystichum munitum — Oxalis oregana* Association. The understory is dominated by a dense cover of *Polystichum munitum*, with many other associated herbs such as *Oxalis oregana*, *Tiarella trifoliata*, *Adiantum pedatum*, *Athyrium filix-femina*, *Blechnum spicant*, *Montia sibirica*, and *Galium triflorum* (fig. CH-2). The shrubby layer is poorly developed, being confined to *Berberis nervosa* and scattered cover of vine maple (*Acer circinatum*), *Vaccinium parvifolium*, *V. ovatum*, and *Rhododendron macrophyllum*. A community related to Bailey's (1966) *Tsuga heterophylla — Pseudotsuga menziesii/Rhododendron macrophyllum/Berberis nervosa* Association occurs on some upper side slopes and narrow ridgetops, particularly those with a southerly or westerly aspect. Shrubs such as *Rhododendron macrophyllum* and *Berberis nervosa* and small hardwoods such as tanoak and golden chinkapin (*Castanopsis chrysophylla*) are much more conspicuous in communities of this type. Conversely, the herbaceous layer is much more poorly developed.

Resident and transient mammals believed to occur within the natural area are listed in table CH-1. The most important mammal, the Roosevelt elk (*Cervus canadensis roosevelti*), utilizes the area and its surroundings heavily. Browsing and trampling by elk is undoubtedly a major influence upon the character of the understory communities within the forest stands and helps account for their relatively open nature. Elk trails provide some of the easiest means for travel through

the area. Heaviest elk use appears to be the broad ridge tops in the center and southern half of the natural area.

There are several miles of live stream course within the natural area. These streams and the streamside areas provide specialized habitats for a variety of flora and fauna. A few minor tributaries of Cherry Creek are located entirely within the natural area and support both steelhead (*Salmo gairdneri*) and sea-run cutthroat trout (*Salmo clarki*).

HISTORY OF DISTURBANCE

Major human influences upon the area are related to the road construction and clearcut logging operations adjacent to the natural area boundaries. Burnt Mountain Road (27-11-12.0), which is located along the northern edge of the natural area, is probably most important in this regard. Construction and maintenance of this road has influenced the slopes below, which are within the natural area. A picnic site and short nature trail have been developed along the western edge of the natural area (Big Tree Site). There is relatively little visitor use of the natural area core because of the lack of trails.

There is no evidence that wildfires have occurred within the natural area for at least 190 years. Nor is there evidence of recent catastrophic damage by windthrow or bark beetles.

RESEARCH

No research studies are presently known to be in progress on the Cherry Creek Research Natural Area. Some data on community structure and limited plant collections have been obtained by Forest Service personnel. The natural area provides an excellent site for studying the old-growth coniferous forest that once typified a large portion of Oregon's Coast Ranges and for studying the effect of Roosevelt elk upon the structure and composition of such communities.

MAPS AND AERIAL PHOTOGRAPHS

Maps applicable to the natural area include: *Topography* — 15′ Sitkum, Oregon quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1955; and *geology* — *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). The District Manager (Coos Bay District, Bureau of Land Management, Coos Bay, Oregon) can provide details on the most recent aerial photo coverage and forest type maps for the area.

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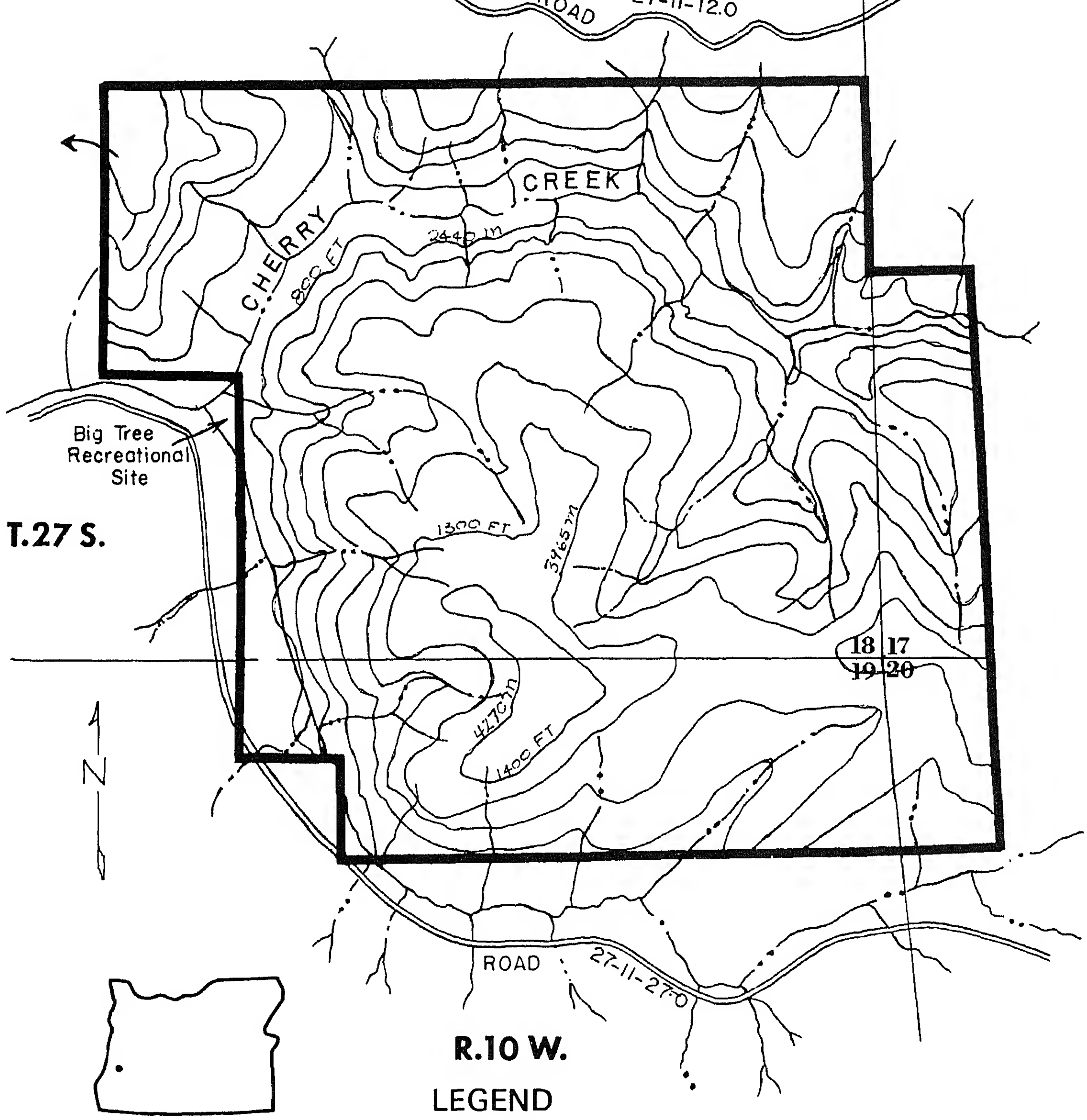
Table CH-1. — Tentative list of mammals for Cherry Creek Research Natural Area[1]

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	**Scapanus orarius*	coast mole
	Sorex bendirii	marsh shrew
	Sorex pacificus	Pacific shrew
	**Sorex trowbridgii*	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
	Sylvilagus bachmani	brush rabbit
Rodentia	*Aplodontia rufa*	mountain beaver
	Arborimus albipes	white-footed vole
	Arborimus longicaudus	red tree vole
	**Castor canadensis*	beaver
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	**Eutamias townsendi*	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Neotoma fuscipes	dusky-footed wood rat
	**Peromyscus maniculatus*	deer mouse
	Spermophilus beecheyi	California ground squirrel
	**Tamiasciurus douglasi*	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Bassariscus astutus*	ringtail or miner's cat
	Canis latrans	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	**Procyon lotor*	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	**Cervus canadensis*	wapiti or elk
	**Odocoileus h. columbianus*	black-tailed deer

[1] Asterisk (*) indicates habitation verified by sign, sighting, or collection.



LEGEND

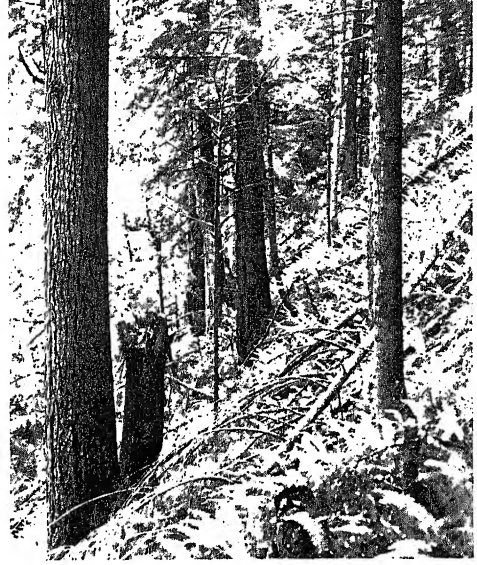
BOUNDARY, CHERRY CREEK RESEARCH NATURAL AREA
SECTION LINE
STREAM
ROAD

0 1/8 1/4 1/2 Mi.

0 1/4 1/2 1 Km.

Figure CH-1.– Cherry Creek Research Natural Area, Coos County, Oregon.

Figure CH-2.—Natural features of Cherry Creek Research Natural Area. Upper left: Stand of western hemlock with dense *Polystichum munitum* understory located on a ridgetop bench. Upper right: Mixed stand of Douglas-fir (left) and western hemlock (right) on steep canyon sideslope. Center: Typical understory species including *Polystichum munitum, Oxalis oregana, Vaccinium ovatum, V. parvifolium,* and *Rhododendron macrophyllum.* Lower left: Open, lower-slope stand of western redcedar, bigleaf maple, and California-laurel. Lower right: Main branch of Cherry Creek near its exit from the natural area.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COQUILLE RIVER FALLS RESEARCH NATURAL AREA[1]

Port-Orford-cedar and Douglas-fir growing in a rugged mountain canyon in the southwestern Oregon Coast Ranges.

The Coquille River Falls Research Natural Area was established on January 31, 1945, to provide examples of virgin old-growth Port-Orford-cedar (*Chamaecyparis lawsoniana*) stands. The 202-ha. (500-acre) tract is located in Coos County, Oregon, and is administered by the Powers Ranger District, Powers, Oregon (Siskiyou National Forest). The natural area occupies portions of sections 16, 17, 18, 20, and 21, T. 33 S., R. 11 W., Willamette meridian. The natural area is bounded by Forest Road 333 on the northwest, by Forest Road 321 on the west, south, and east, and by the center line of sections 16 and 17 on the north (fig. CO-1). It lies at 42°44′ N. latitude and 124°03′ W. longitude.

ACCESS AND ACCOMMODATIONS

Primary access is via State Highway 242 and Powers, which lies 29 km. (18 miles) south of State Highway 42 and about 34 and 48 km. (21 and 30 miles) from Myrtle Point and Coquille, respectively. To reach the natural area, travel south from Powers on Forest Road 333 for about 33 km. (20 miles) to the bridge across the South Fork of the Coquille River. This bridge is located on the northwest boundary of the tract. For the next several kilometers Roads 333 and 321 bound the natural area.

Generally, cross-country travel is necessary within the natural area. Immediately east of Squaw Creek an unmarked trail leads from Road 321 down to Coquille River Falls. The upper- and mid-slopes of the natural area on the south side of the river are reasonably accessible from the road. Access to the lower slopes and area of the river is difficult, however. The best way to reach the latter is from the northwestern corner of the natural area entering just north of the bridge where Road 333 crosses the South Fork of the Coquille River.

The nearest commercial accommodations are in Powers, Myrtle Point, Coquille, and Gold Beach; however, there are several improved forest camps along Forest Road 333 in the vicinity of the natural area: Daphne Grove, Myrtle Grove, and Boundary.

ENVIRONMENT

The Coquille River Falls Research Natural Area occupies a topographically rugged canyon area. Except for a few benches along Road 321, slopes are moderate to very steep. Cliffs and rock outcrops are occasionally encountered and are very common along the river itself (fig. CO-2). The South Fork of the Coquille River and numerous other streams such as Squaw and Drowned Out Creek flow through the southern part of the natural area. Spring and seep areas are also common. Elevations within the natural area range from 305 to 760 m. (1,000 to 2,500 ft.).

The natural area is relatively simple geologically (Diller 1903, Wells 1955, and Peck 1961). Bedrock is composed of sedimentary materials, primarily sand and siltstones, belonging to the Tyee formation of Eocene age.

The climate is wet and mild. Precipitation

[1] Description prepared by Dr. J. F. Franklin and Dr. C. T. Dyrness, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

is seasonal, with a peak in January and December and a minimum in July and August. The summer drought period is more pronounced than in the northern Oregon and Washington coastal mountains. The following climatic data are from the closest weather station at Powers (U.S. Weather Bureau 1965):

Mean annual temperature	12.0°C. (53.6°F.)
Mean January temperature	6.6°C. (43.8°F.)
Mean July temperature	17.6°C. (63.6°F.)
Mean January minimum temperature	1.6°C. (34.8°F.)
Mean July maximum temperature	25.0°C. (77.0°F.)
Average annual precipitation	1,535 mm. (60.44 in.)
June through August precipitation	56 mm. (2.19 in.)

Since Powers is about 150 m. (500 ft.) lower in elevation, temperatures are lower and precipitation higher on the natural area; isohyetal maps (Oregon State Water Resources Board 1959) indicate 2,500 to 2,800 mm. (100 to 110 in.) annual precipitation.

Soils vary greatly in depth throughout the area. The profiles typically are not strongly developed. On better sites, soils tend toward Reddish-Brown Lateritics with 5- to 10-cm. (2- to 4- in.) thick A1 horizons. These profiles are typically developed in relatively deep colluvial deposits. Soils are generally much shallower on the slopes north of the Coquille River, where either Brown Podzolic or Lithosolic types may be encountered.

BIOTA

All of the natural area is classed as SAF cover type 231, Port-Orford-Cedar-Douglas-Fir (Society of American Foresters 1954). The area falls within Küchler's (1964) Type 2, Cedar-Hemlock-Douglas Fir Forest, and the *Tsuga heterophylla* Zone of Franklin and Dyrness (1969).

Port-Orford-cedar and Douglas-fir (*Pseudotsuga menziesii*) are the most important tree species within the natural area composing approximately 22 percent and 69 percent of the total timber volume (fig. CO-2). There are particularly fine specimens of Port-Orford-cedar on the benches along Forest Road 321 (fig. CO-2); these trees attain diameters in excess of 130 cm. (50 in.) b.h. and heights in excess of 60 m. (200 ft.) Western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), sugar pine (*Pinus lambertiana*), and Pacific yew (*Taxus brevifolia*) are other coniferous tree species found within the tract. Hardwoods are well represented though not necessary in the highest canopy levels. These include red alder (*Alnus rubra*), tanoak (*Lithocarpus densiflorus*), golden chinkapin (*Castanopsis chrysophylla*), and Pacific madrone (*Arbutus menziesii*).

General successional trends are toward replacement of Douglas-fir and Port-Orford-cedar by western hemlock. Hemlock seedlings and saplings are the most abundant in mature forest stands, while those of grand fir and Port-Orford-cedar are relatively uncommon or absent. However, sprout and seedling reproduction of tanoak is as abundant as or more so than than of western hemlock in some stands, suggesting it may also be a major climax species.

There are a variety of distinctive forest communities found within the natural area. Most conspicuous are the old-growth coniferous stands dominated by Port-Orford-cedar and Douglas-fir which are concentrated south of the Coquille River. *Polystichum munitum* dominates the understory on moist benches as well as on well watered slopes or in seep areas. Typical associated species are *Oxalis oregana*, *Berberis nervosa*, *Galium triflorum*, *Viola sempervirens*, *Hierchloe occidentalis*, and *Trillium ovatum*. Shrubs commonly encountered on such sites are *Vaccinium ovatum*, tanoak, and *Gaultheria shallon*.

Other old-growth stands, e.g., those found on drier sites, may have a dense understory of shrubs and small trees such as *Rhododendron macrophyllum*, *Vaccinium parvifolium*, *P. ovatum*, tanoak, golden chinkapin, *Gaultheria shallon*, and *Berberis nervosa*. Herbaceous species include many of those found on moister sites (e.g., *Polystichum munitum*), but coverage of the herbaceous layer is typically much lower.

Younger, second-growth stands growing on relatively poor sites typify the natural area north of the Coquille River. Douglas-fir

and Port-Orford-cedar are the most important coniferous tree species present, but sugar pine is also found in these stands. Hardwoods, such as golden chinkapin, tanoak, and Pacific madrone, are much more important than in the older stands, and the understory is dominated by shrubs such as *Rhododendron macrophyllum*, *Gaultheria shallon*, and *Berberis nervosa*.

There are some small areas of *Alnus rubra/Polystichum munitum* communities scattered through the southern half of the natural area (fig. CO-2). There is relatively little evidence of successional direction in these stands; reproduction is lacking in almost all species.

Mammals believed to reside or occur as transients within the natural area are listed in table CO-1. A variety of amphibians, such as frogs and salamanders, are associated with the streams and seep areas. Ensatina (*Ensatina eschscholtzi*), Pacific giant salamander (*Dicamptodon ensatus*), and clouded salamanders (*Aneides ferreus*) have been collected within the natural area.

Specialized habitats within the Coquille River Falls Research Natural Area include the stream and stream side areas and the rock cliffs found along the South Fork of the Coquille River (fig. CO-2).

HISTORY OF DISTURBANCE

The most serious disruptive influence has been the recent invasion of an exotic root pathogen, *Phytopthora lateralis*, which is invariably fatal to Port-Orford-cedar. In 1966 the pathogen was not known to be present in the natural area and there were no cedar dying at that time. By 1968 dying Port-Orford-cedar were common along Road 321 and extended down the drainages north of this road. This follows the typical pattern of invasion for this pathogen. In 1970 nearly half (47 percent) of the Port-Orford-cedar volume was in snags and down trees in contrast to 16 percent in the nearby, but not yet infested, Port Orford Cedar Research Natural Area.[2] It is expected that most of the stands on the south side of the South Fork of the Coquille River will eventually become infected.

Severe fire scars are present on the old Port-Orford-cedar and Douglas-fir (fig. CO-2). These scars and the scattering of youthful red alder stands are evidence of periodic wildfires in the area prior to the establishment of fire control programs. None appear to have occurred in recent years.

Human disturbance of the area is confined to the road and trail side areas and to the vicinity of Coquille River Falls which receives moderate visitor use.

RESEARCH

There are no research studies in progress on the Coquille River Falls Research Natural Area. Some data on community structure and limited plant collections have been obtained by Forest Service personnel.

This natural area compliments the larger Port Orford Cedar Research Natural Area located about 5 km. (2 miles) to the northwest. Research opportunities include studies of: (1) variation in forest composition, structure, and dynamics under contrasting environmental and stand conditions; and (2) fauna and flora associated with rock outcrops and cliffs found in a major river canyon. The recent and rapidly progressing invasion of the area by *Phytopthora lateralis* makes studies of the communities and the ecological impacts of the pathogen upon them especially timely.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Agness, Oregon quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1954; and *geology* — *Description of the Port Orford Quadrangle*, scale 1:250,000 (Diller 1903), *Preliminary Geologic Map of Southwestern Oregon. . .*, scale 1:250,000 (Wells 1955), and *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). Either the District Ranger (Powers Ranger District) or

[2] Unpublished cruise data on file at Powers Ranger Station, Siskiyou National Forest, Powers, Oregon.

Forest Supervisor (Siskiyou National Forest, Grants Pass, Oregon) can provide details on the most recent aerial photo coverage and forest type maps for the area.

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Table CO-1. — Tentative list of mammals for Coquille River Falls Research Natural Area[1]

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	**Scapanus orarius*	coast mole
	Sorex bendirii	marsh shrew
	Sorex pacificus	Pacific shrew
	**Sorex trowbridgii*	Trowbridge shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Arborimus albipes	white-footed vole
	**Arborimus longicaudus*	red tree vole
	Castor canadensis	beaver
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	**Eutamias townsendi*	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus oregoni	Oregon or creeping vole
	**Peromyscus maniculatus*	deer mouse
	**Tamiasciurus douglasi*	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Bassariscus astutus*	ringtail or miner's cat
	Canis latrans	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	**Cervus canadensis roosevelti*	Roosevelt elk
	**Odocoileus h. columbianus*	black-tailed deer

[1] Asterisk (*) indicates habitation verified by sign, sighting, or collection.

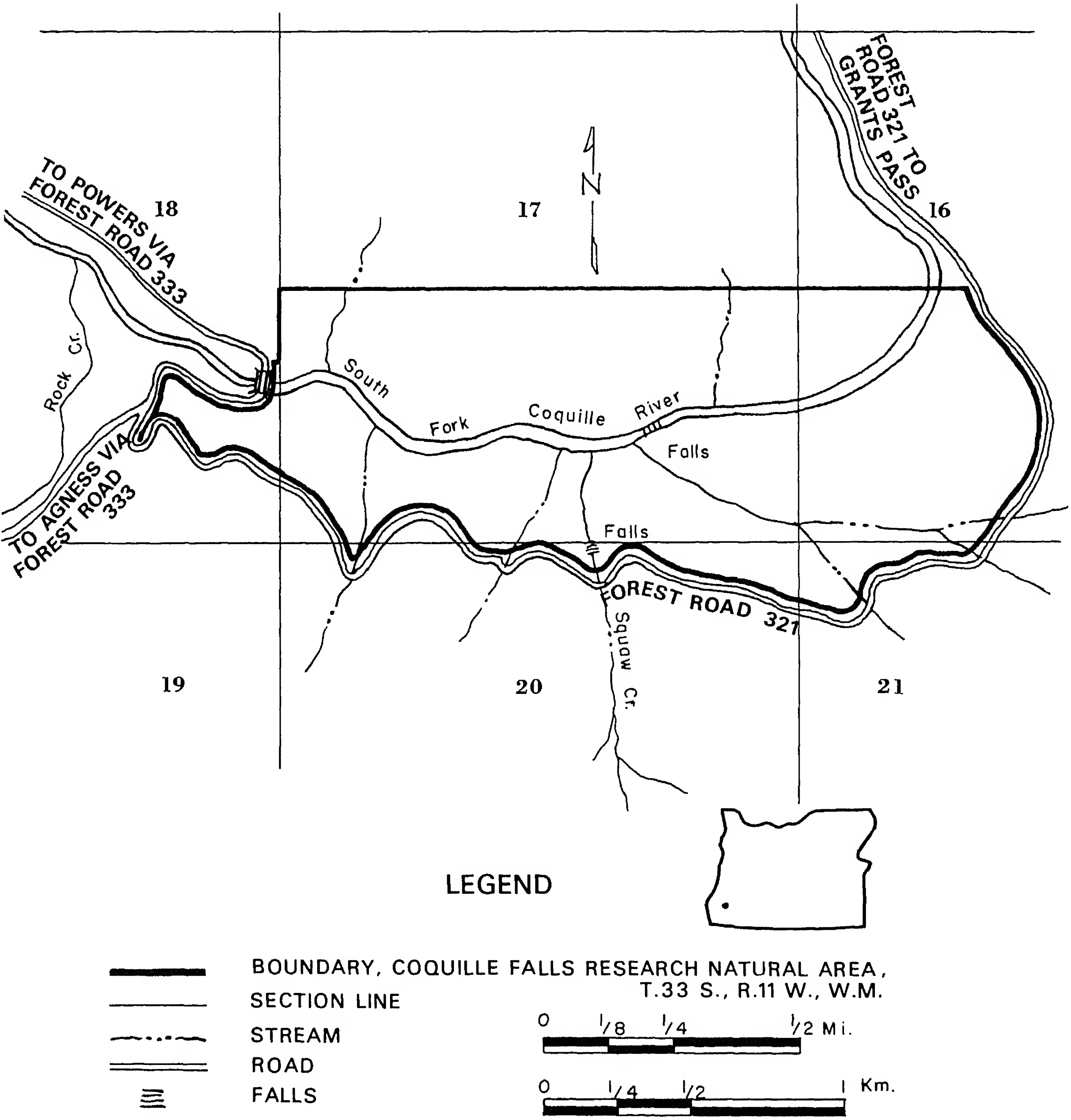
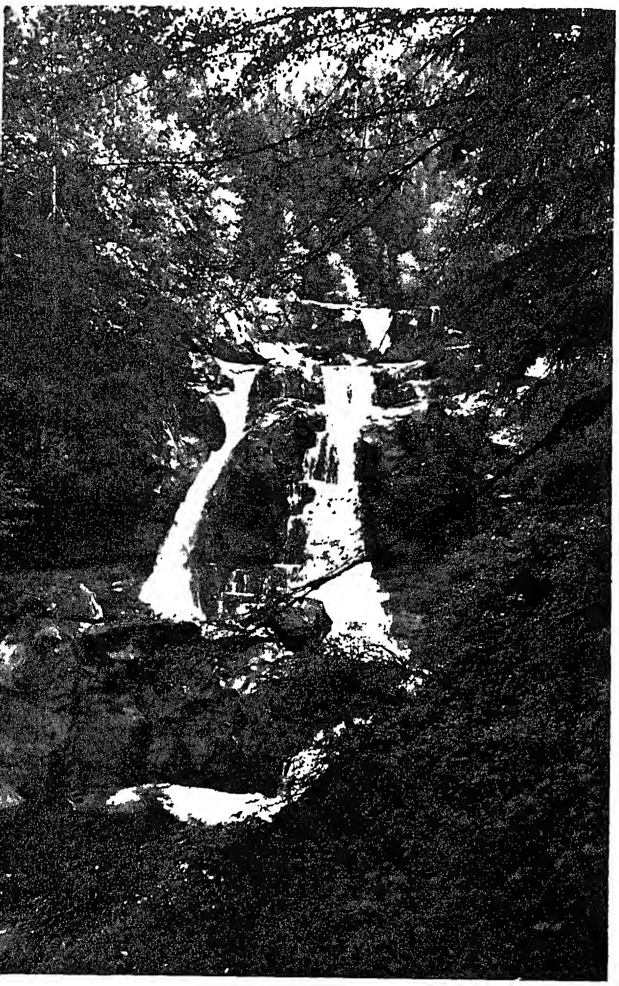


Figure CO-1.– Coquille River Falls Research Natural Area, Coos County, Oregon.

Figure CO-2.—Natural features of the Coquille River Falls Research Natural Area. A: Coquille River Falls near the center of the natural area. B: Fire scar on otherwise vigorous specimen of Port-Orford-cedar; scars are common on old-growth cedars and Douglas-fir within the natural area. C: Grove of old-growth Port-Orford-cedar on a bench near the southern edge of the natural area.



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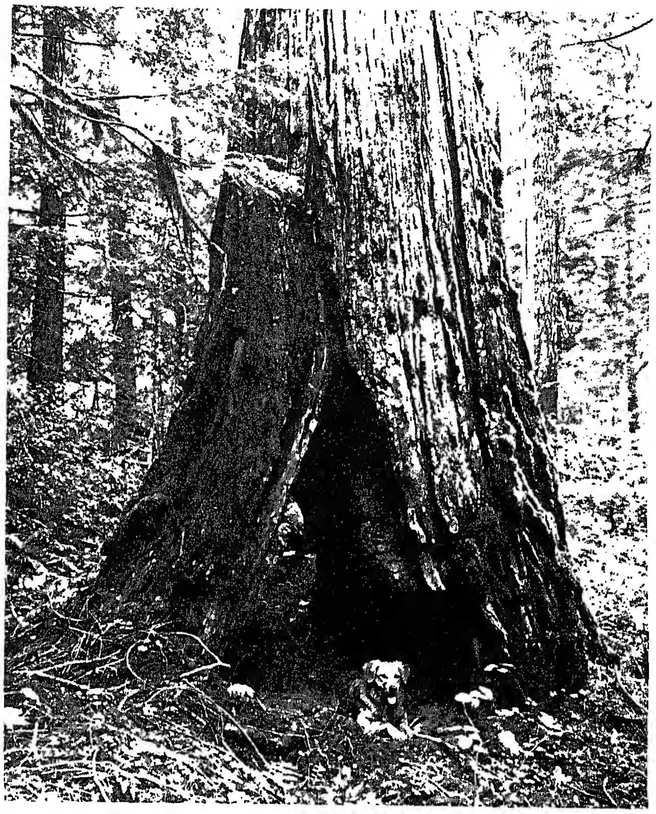

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Figure CO-2.—Natural features of the Coquille River Falls Research Natural Area (continued). D: Mixed forest of Douglas-fir (left and center background), tanoak (right), and Port-Orford-cedar (center background); note the dense understory of *Polystichum munitum.* E: Typical example of the *Alnus rubra/Polystichum munitum* communities scattered through the southern half of the natural area. F: Typical mature specimen of Port-Orford-cedar.

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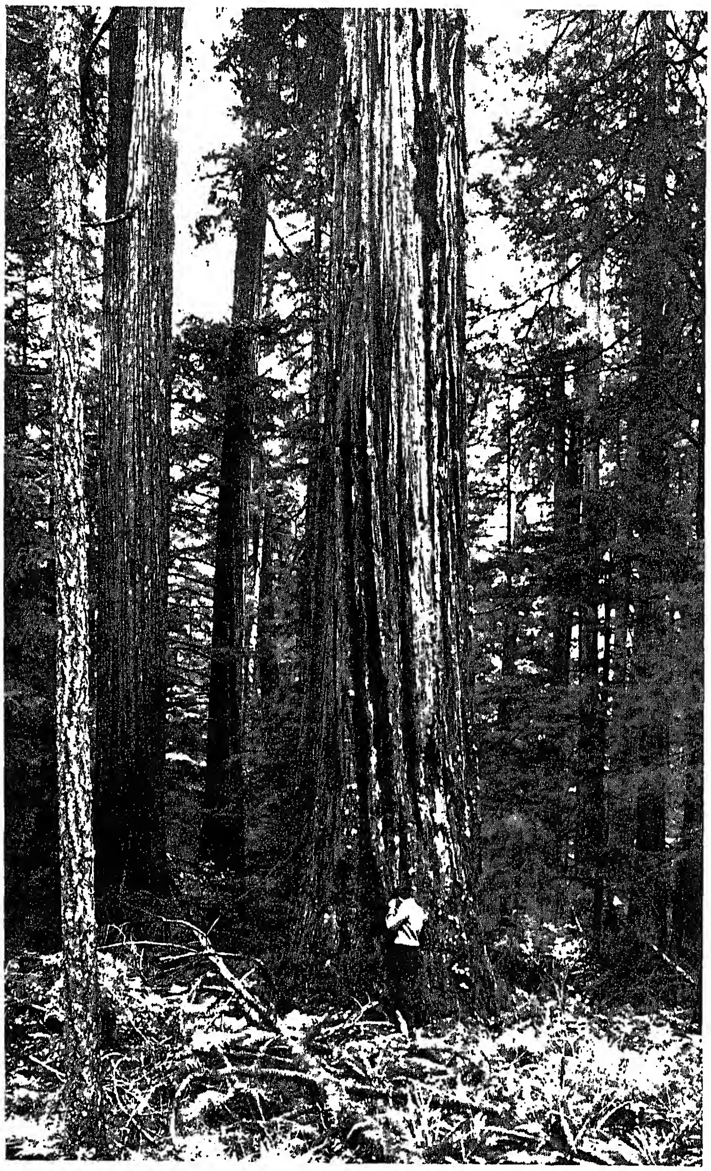

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DIAMOND POINT RESEARCH NATURAL AREA[1]

Second-growth western hemlock, Sitka spruce, and red alder growing on an island in a coastal estuary in southwestern Washington.

The Diamond Point Research Natural Area was established as an example of second-growth Sitka spruce (*Picea sitchensis*) - western hemlock (*Tsuga heterophylla*) forest growing on a peninsula in a coastal estuary. The 36-ha. (88-acre) tract is located in Pacific County, Washington, and is administered by the Bureau of Sport Fisheries and Wildlife. It is located at the northern tip of Long Island in Willapa Bay and is part of Willapa National Wildlife Refuge (Ilwaco, Washington). The natural area occupies a portion of the northern half of section 25, T. 12 N., R. 11 W., Willamette meridian (fig. DP-1). It lies at 46°29′ N. latitude and 123°59′ W. longitude.

ACCESS AND ACCOMMODATIONS

Access to the vicinity is via U.S. Highway 101 to headquarters of the Willapa National Wildlife Refuge, located approximately 21 km. (13 miles) north of Ilwaco, Washington. The headquarters site is opposite the southern end of Long Island, and the Bureau maintains a boat and docking facilities for the 0.5-km. (0.3-mile) trip to the island. On the island there is a limited logging road system which comes within 0.8 km. (0.5 mile) of the southern boundary of the natural area. The sole means of transportation on Long Island is a jeep maintained by the Bureau of Sport Fisheries and Wildlife. An alternative approach is by boat, going from the headquarters dock directly to the natural area — a trip of perhaps 10 to 14 km. (6 to 8 miles). There are no trails in the natural area, so access is by cross-country hiking or walking along the shoreline at low tide.

A wide range of commercial accommodations are available at Ilwaco, Seaview, and Long Beach, about 19 to 22 km. (12 to 14 miles) south of Willapa National Wildlife Refuge headquarters. There are seven public campgrounds on Long Island, all of them reached by boat. One of them — Diamond Point Campground — is actually located within the boundaries of the natural area.

ENVIRONMENT

Topography on the Diamond Point Research Natural Area is, for the most part, composed of moderate slopes along several broad ridges which are interrupted by short drainage channels. There are small areas of steeper slopes, notably along the northwest-facing shore where slopes plunge abruptly to the bay. Elevations range from sea level to just over 30 m. (100 ft.). The natural area is bounded on the east, north, and west by approximately 1.2 km. (3/4 mile) of shoreline.

Geologically the Diamond Point Research Natural Area is made up of marine terraces of Pliocene to Pleistocene age (Huntting et al. 1961). These terraces are characterized by alternating beds of unconsolidated to partly consolidated silt, clay, and sand.

The area has a pronounced cool and wet marine climate. Although a large proportion of the total annual precipitation occurs during the winter, there is sufficient rainfall and foggy weather during the summer to maintain relatively high levels of soil moisture. Not only does fog reduce potential evapo-

[1] Description prepared by Dr. C. T. Dyrness, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

transpiration, it also results in moisture accretion by "fog drip" from tree crowns. Temperature range throughout the year is minimal; winter temperatures are relatively mild and summers tend to be cool. The following climatic data are from the Willapa Harbor Climatic Station (U.S. Weather Bureau 1965):

Mean annual temperature	10.6°C. (51.1°F.)
Mean January temperature	4.6°C. (40.3°F.)
Mean July temperature	16.3°C. (61.4°F.)
Mean January minimum temperature	1.2°C. (34.1°F.)
Mean July maximum temperature	22.0°C. (71.5°F.)
Average annual precipitation	2,156 mm. (84.87 in.)
June through August precipitation	149 mm. (5.87 in.)

Even though the Willapa Harbor Climatic Station is located about 26 km. (16 miles) northeast of the natural area, climatic conditions should be roughly the same at both locations.

Soils information for the area is from a limited number of observations. Apparently most soils are Sols Bruns Acides with textural profiles largely inherited directly from the stratified parent material. Forest floor layers (01 and 02 horizons) are generally thick, ranging from 13 to 25 cm. (6 to 10 in.) in depth. These layers often contain a large proportion of the total root mass. The surface mineral horizon, averaging about 8 cm. (3 in.) in thickness, consists of very dark brown to black silt loam and obviously contains a large amount of incorporated organic matter. This is underlain by a dark brown, silt loam to silty clay loam horizon which ranges from 13 to 25 cm. (6 to 10 in.) in thickness. The subsoil material may vary from a partially indurated sand to a sticky clay, depending on parent material stratigraphy. In some locations the subsoil shows pronounced mottling, indicating impeded internal drainage.

BIOTA

Estimated areas by SAF cover types (Society of American Foresters 1954) are:

No.	*Name*	*Area*
225	Sitka Spruce — Western Hemlock	18 ha. (45 acres)
224	Western Hemlock	10 ha. (25 acres)
221	Red Alder	7 ha. (18 acres)

The area falls within Küchler's (1964) Type 1, Spruce-Cedar-Hemlock Forest, and the *Picea sitchensis* Zone of Franklin and Dyrness (1969).

There are only three tree species of any importance in the natural area: red alder (*Alnus rubra*), Sitka spruce, and western hemlock. Most of the stands appear to be approximately 70 to 80 years old, having resulted from logging of the area some time near the turn of the century. Composition of coniferous stands ranges from Sitka spruce, with minor amounts of hemlock on north and west facing slopes, to pure stands of western hemlock on ridgetops and south slopes. Tree regeneration under spruce-hemlock stands usually consists of scattered stems of both spruce and hemlock. Red alder also occasionally occurs in small openings. In stands where hemlock is the dominant tree in the overstory, regeneration is dominantly western hemlock with very few Sitka spruce. Pure, even-aged stands of red alder occur in drainageways and in low areas along the shoreline.

Tree overstory coverage in coniferous stands varies from about 60 to 75 percent. In the denser alder stands it averages 90 to 100 percent. Typical western hemlock and Sitka spruce trees are from 30- to 46-cm. (12- to 18-in.) d.b.h., with the largest specimens ranging up to 91-cm. (36-in.) d.b.h.

There are two main understory community types in coniferous stands within the natural area: (1) the *Polystichum munitum* type found in moist areas where Sitka spruce is the dominant tree species, and (2) a *Gaultheria shallon* type generally associated with hemlock-dominated timber stands. The *Polystichum* community is characterized by only scattered shrub cover contributed mainly by *Vaccinium parvifolium, V. ovatum, Rhamnus purshiana, Sambucus melanocarpa, and Rubus spectabilis. Gaultheria shallon*, if present, is often restricted to rotten logs and stumps. The herb layer is dominated by a luxurious growth of *Polystichum munitum* which may cover as much as 80 percent of the ground surface. Other common herbaceous species include *Blechnum spicant, Athyrium filix-femina, Galium triflorum, Pyrola uni-*

flora, Luzula parviflora, Maianthemum bifolium var. *kamtschaticum, Lysichitum americanum, Dryopteris dilatata, Oxalis oregana, Tiarella trifoliata, Trillium ovatum,* and *Monotropa hypopitys*. A heavy growth of moss covers the ground in all coniferous stands. Average moss cover is generally 80 to 90 percent, with *Eurynchium oreganum* probably the most common species.

The *Gaultheria* community is dominated by large amounts of *Gaultheria shallon*, some of it up to 2 m. (6 ft.) in height. Other common shrubs are *Vaccinium parvifolium, V. ovatum, Rhamnus purshiana,* and *Menziesia ferruginea*. The herb layer is scattered and made up of species such as *Polystichum munitum, Blechnum spicant, Dryopteris dilatata, Polypodium scouleri* (both on the ground and as an epiphyte), *Galium triflorum, Luzula parviflora,* and *Osmorhiza nuda*.

The vegetation under pure stands of red alder in drainages and swampy swales is made up of the above mentioned ferns, *Lysichitum americanum, Montia sibirica, Carex* spp., *Cardamine* sp., *Melissa officinalis, Equisetum* sp., and a variety of other moisture-loving species. Several low-lying alder stands adjacent to the bay have an almost pure *Carex* understory which is unusually lush and dense (fig. DP-2).

Mammals believed to utilize the area as either residents or transient visitors are listed in table DP-1. Birds frequenting the area include band-tailed pigeons (*Columba fasciata*), bluegrouse (*Dendragapus obscurus*), and ruffed grouse (*Bonasa umbellus*).

HISTORY OF DISTURBANCE

As previously mentioned, the area was logged some 70 to 80 years ago. Since then, there appears to have been very little additional disturbance by man. There is a small, primitive campground (Diamond Point Campground) reached only by water near the northwestern corner of the area, but so far the user-related disturbances do not extend very far inland. All of Long Island is a big-game, bow-hunting area, and hunters undoubtedly pass through the area, but effects of this use appear negligible. There is, however, considerable evidence of heavy browsing of shrubs and ferns by deer and elk in some of the more open stands.

In 1966 a clearcut logging operation came close to the southern boundary of the natural area. Because of the lack of natural area boundary markers, it is difficult to tell exactly how much of a buffer, if any, remains between the clearcut and the natural area.

RESEARCH

No research is currently being conducted in the area and, so far as is known, none has been conducted in the past. The natural area offers a good opportunity for studying the development of young second-growth stands of western hemlock, Sitka spruce, and red alder.

MAPS AND AERIAL PHOTOGRAPHS

Maps covering the natural area are: *Topography* — 15′ Fort Columbia, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1938; 7 1/2′ Long Island, Washington quadrangle, scale 1:31,250, issued by the U.S. Geological Survey in 1949; *geology* — *Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). The Refuge Manager of the Willapa National Wildlife Refuge (Ilwaco, Washington) can provide information on recent aerial photographs and maps.

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Table DP-1. — Tentative list of mammals for Diamond Point Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Ondatra zibethicus	muskrat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Felis concolor*	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer

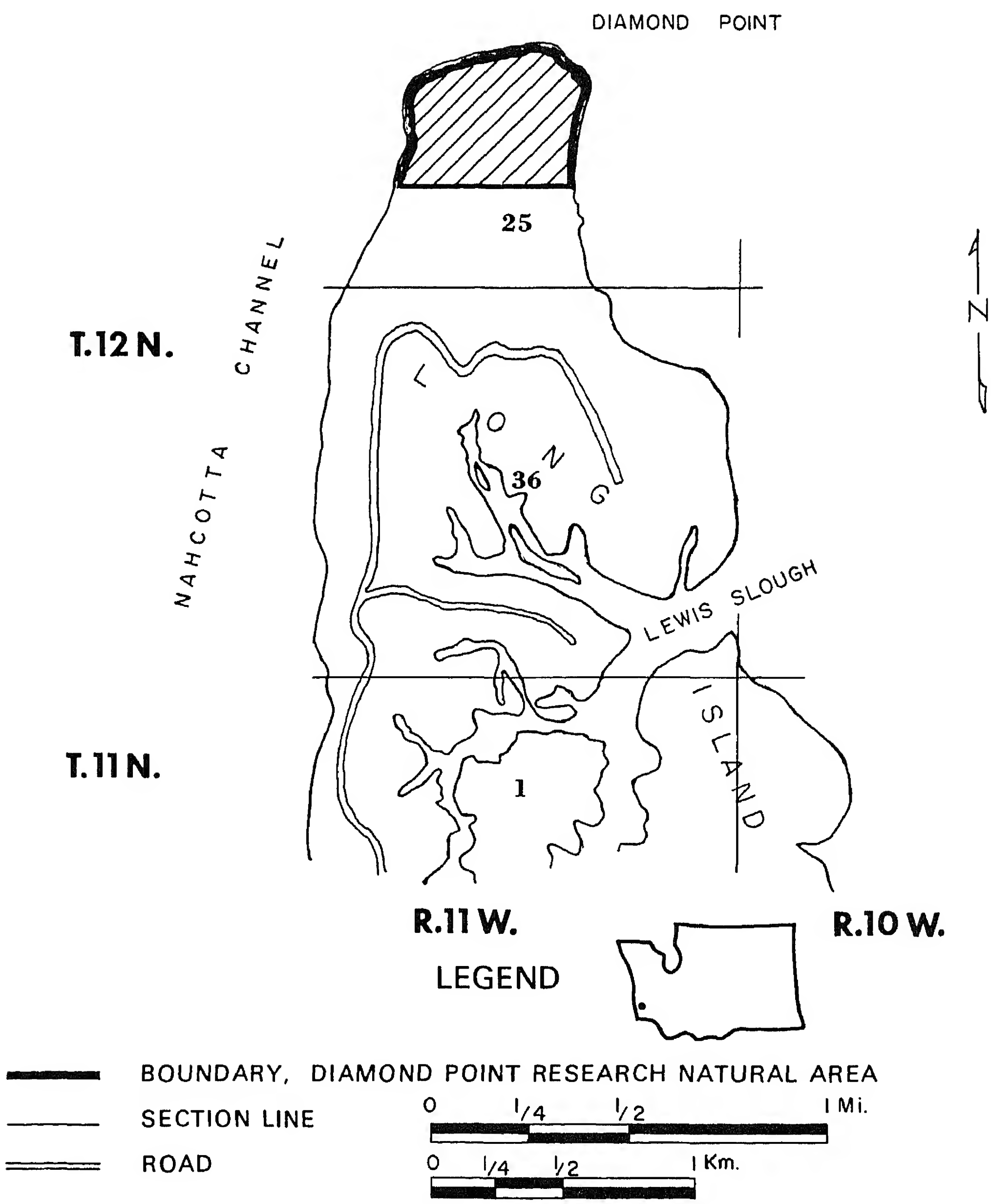

Figure DP-1.– Diamond Point Research Natural Area, Pacific County, Washington.

Figure DP-2.—Communities of the Diamond Point Research Natural Area. Upper left: Shoreline of the natural area near Diamond Point Campground. Upper right: A red alder stand with a dense *Carex* understory. Lower left: Sitka spruce-western hemlock with a *Polystichum munitum* understory in the foreground, grading into a *Tsuga heterophylla/Gaultheria shallon* community in the background. Lower right: *Tsuga heterophylla/Gaultheria shallon* community on a ridgetop.

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GOLD LAKE BOG RESEARCH NATURAL AREA[1]

Subalpine bog communities and flora and surrounding forest lands near the crest of the Oregon Cascade Range.

The Gold Lake Bog Research Natural Area was established August 10, 1965, to preserve some prime subalpine bogs and several species of rare bog plants. The 188-ha. (463-acre) tract is located in Lane County, Oregon, and is administered by the Oak Ridge Ranger District (Oak Ridge, Oregon), Willamette National Forest. The natural area occupies most of the S1/2 S1/2 section 20 and N1/2 section 29, T. 22 S., R. 6 E., Willamette meridian. Legal lines provide most of the boundary except for the southeastern quarter, where the boundary follows Skyline Creek and Forest Trail 3681 (Maiden Peak Trail) for a portion of its length (fig. GL-1). The natural area lies at 43°39′ N. latitude and 120°01′ W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area lies a short distance north of Willamette Summit on Oregon State Highway 58. There are several easy access routes into the tract. The Waldo Lake Road (Forest Road 204) bounds the northwestern corner of the natural area. The northwestern and southeastern corners of the tract can be reached by easy hikes from the end of the Gold Lake Road (Forest Road 223), via Forest Trails 3677 or 3681, respectively. The southwestern corner of the tract can also be reached by boat travel across Gold Lake from the Gold Lake Forest Camp. Wet areas, ponds, and stream courses do make cross-country travel through the boggy portions of the natural area somewhat difficult at times.

The nearest commercial accommodations are found at Odell and Crescent Lake, along Oregon State Highway 58 east of Willamette Summit. There are numerous improved forest camps in the vicinity, including one at the outlet of Gold Lake, less than a mile from the natural area.

ENVIRONMENT

The bulk of the research natural area is located in a basin between two mountain slopes at the head of Gold Lake. The topography is essentially flat, except in the northwestern and southeastern corners, where lower mountain slopes have been incorporated within the tract. Three small ponds located within the bog are estimated to total about 1.5 ha. (4 acres). Three major streams (Ray, Salt, and Skyline Creeks) converge and flow through the tract. Elevations range from 1,463 to 1,646 m. (4,800 to 5,400 ft.).

Gold Lake Bog Research Natural Area is located in the volcanic High Cascades. Bedrock is composed of Pleocene-Pleistocene olivine basalt and basaltic andesite (Williams 1957). It is covered by aeolian deposits of volcanic ash and dacitic pumice, much of which came from the Mount Mazama eruption 6,600 years ago.

A cool, wet climate prevails. Most precipitation occurs during the winter months, and much of this accumulates in snow packs which probably attain maximum depths of 2 to 3 m. (6 to 9 ft.) on the average. Summers are relatively dry, and drought periods of 1 to 2 months are not uncommon. Climatic data from a weather station located about

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

8 km. (5 miles) southeast of the natural area at 1,459-m. (4,788-ft.) elevation (Odell Lake Land Pan in U.S. Weather Bureau 1965) are as follows:

Mean annual temperature	4.8°C. (40.6°F.)
Mean January temperature	-3.6°C. (25.6°F.)
Mean July temperature	14.6°C. (58.3°F.)
Mean January minimum temperature	-7.5°C. (18.5°F.)
Mean July maximum temperature	23.7°C. (74.6°F.)
Mean annual precipitation	1,533 mm. (60.37 in.)
June through August precipitation	86 mm. (3.39 in.)
Average annual snowfall	834 cm. (329.00 in.)

Temperatures are somewhat cooler and precipitation higher on the natural area itself; isohyetel maps indicate 1,800 to 2,000 mm. (70 to 80 in.) of precipitation are to be expected on the tract.

Soils within the natural area have not been mapped or described. In upland areas they appear to be nondescript, Brown Podzolic forest soils developed in volcanic ash. Most of the ash is probably from the eruption of Mount Mazama 6,600 years ago. Organic soil profiles are encountered in the low-lying boggy areas.

BIOTA

Approximately 75.7 ha. (187 acres) of the Gold Lake Bog Research Natural Area are occupied by bogs and marshes, 1.6 ha. (4 acres) by ponds, and 117.2 ha. (272 acres) by subalpine forest. The forested acreage can arbitrarily be divided into 58.6 ha. (136 acres) of SAF cover type 206, Engelmann Spruce - Subalpine Fir, and 58.6 ha. (136 acres) of type 205, Mountain Hemlock-Subalpine Fir (Society of American Foresters 1954). The Engelmann spruce (*Picea engelmannii*) - subalpine fir (*Abies lasiocarpa*) forests tend to occur around the periphery of the bogs and marshes, and the mountain hemlock (*Tsuga mertensiana*) - subalpine fir forests are found in upland portions of the tract. Küchler (1964) types represented would probably include Fir-Hemlock Forest (4) and Western Spruce - Fir Forest (15). The natural area is at the boundary of the *Abies amabilis* and *Tsuga mertensiana* Zones described by Franklin and Dyrness (1969).

The key features of the natural area are the bogs and marshes, but complete descriptions of these communities are not available. Most of the common bog plants occur, including sphagnum moss, *Eriophorum* spp., *Menyanthes trifoliata*, and *Kalmia polifolia*. Five species of carnivorous plants occur within the natural area: *Drosera longifolia*, *Drosera rotundifolia*, *Utricularia intermedia*, *Utricularia minor*, and *Utricularia vulgaris*. Another relatively rare plant, *Scheuchzeria palustris*, is also found in the bogs. The area is believed to incorporate several of the best examples of the sphagnum bogs found in the central Oregon Cascade Range.

The timbered area includes Engelmann spruce, subalpine fir, mountain hemlock, Pacific silver fir (*Abies amabilis*), Shasta red fir (*Abies magnifica* var. *shastensis*), lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and Douglas-fir (*Pseudotsuga menziesii*) as constituent species. As mentioned, there appear to be two major forest types present. Low-lying forests bordering marshes and bogs are typically dominated by Engelmann spruce and subalpine fir. Reproduction is composed primarily of mountain hemlock and subalpine fir. Engelmann spruce attains diameters of 110 cm. (45 in.) b.h. and heights of 50 m. (160 ft.). However, many of the stands have suffered recent mortality, with windthrow being the most common agent killing the spruce and insects, the subalpine fir. Common understory species are *Viola sempervirens*, *Chimaphila umbellata*, *Pyrola secunda*, *Xerophyllum tenax*, *Clintonia uniflora*, *Rubus lasiococcus*, and *Tiarella unifoliata*.

The drier upland forests are very mixed in composition with mountain hemlock, Shasta red fir, Douglas-fir, and western white pine typically most conspicuous. The Shasta red fir and western white pine are usually largest, occasional specimens exceeding 100-cm. (40-in.) d.b.h. and 52 m. (175 ft.) in height. Mountain hemlock and Pacific silver fir often dominate the reproduction. The understory is typically sparse with species such as *Vaccinium membranaceum*, *V. scoparium*, and *Xerophyllum tenax* present.

Beaver (*Castor canadensis*) are probably the most important animals influencing natural processes within the natural area. They have developed dams and runways in some marshy areas (fig. GL-2). The natural area is used as summer range by elk (*Cervus canadensis*), blacktail deer (*Odocoileus hemionus columbianus*), and mule deer (*Odocoileus hemionus*). Badger (*Taxidea taxus neglecta*) have also been observed within the tract; their occurrence west of the summit of the Cascade Range is unusual. A complete list of mammals believed to utilize the natural area is provided in table GL-1. Birds commonly found within the natural area include blue grouse (*Dendragapus obscurus*), mountain quail (*Oreortyx pictus*), mourning doves, (*Zenaidura macroura*), band-tailed pigeons (*Columbia fasciata*), mallard ducks (*Anas platyrhyncos*), and wood ducks (*Aix sponsa*). Gold Lake is stocked with rainbow trout which have moved up into the ponds and streams within the natural area.

Several species of amphibians are known to inhabit Gold Lake Bog. The Cascade frog (*Rana cascadae*) is found near the exterior of the bog, and the western spotted frog (*Rana pretrosa*) inhabits the interior of the bog. These two closely related species are probably genetically compatible in their ability to hybridize. The northwestern tree toad (*Hyla regilla*) is also found within the area.

HISTORY OF DISTURBANCE

The major human disturbance to the natural area has been the removal of beaver dams from the main stream channel by the Oregon State Game Commission to provide access for spawning rainbow trout from Gold Lake. Since the dams appear to be of major importance in maintaining high water levels in the marshes and bogs, this practice has been discontinued since establishment of the natural area. Beaver populations have reportedly decreased considerably in the last few years, a possible consequence of trapping which is not yet prohibited on the tract. Recreationists have caused some minor disturbances; these are confined primarily to trailside areas. Open grasslands above the bog have been used as a base camp for hunters in the late fall, however. Such use is now prohibited, and public recreational use of the bogs and marshes is discouraged.

Wildfires have undoubtedly occurred over the natural area in past centuries; however, there is no evidence of recent wildfires.

RESEARCH

Some research on plant communities[2] and amphibian fauna[3] have been carried out within the natural area.

The natural area is, of course, particularly valuable as a site for the study of the ecology of bog and marsh communities and the fauna associated with them. It provides a refugium for the protection of six uncommon species of bog plants and a site for studying the environmental (habitat) and breeding relationships of two species of frogs. The natural area is also well suited to studies of variation in composition, structure, and productivity of forest communities along an environmental gradient extending from wet, low-lying to dry, upland areas.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Waldo Lake, Oregon quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1956; and *geology* — *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961), and *Geologic Map of the Central Part of the High Cascade Range, Oregon* (Williams 1957). Either the District Ranger (Oak Ridge Ranger District) or Forest Supervisor (Willamette National Forest, Eugene, Oregon) can provide details on the most recent aerial coverage and forest type maps for the area.

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[2] Research by Dr. John Rumley, Montana State University, Bozeman.

[3] Research by Dr. James Kezar, Department of Biology, University of Oregon, Eugene.

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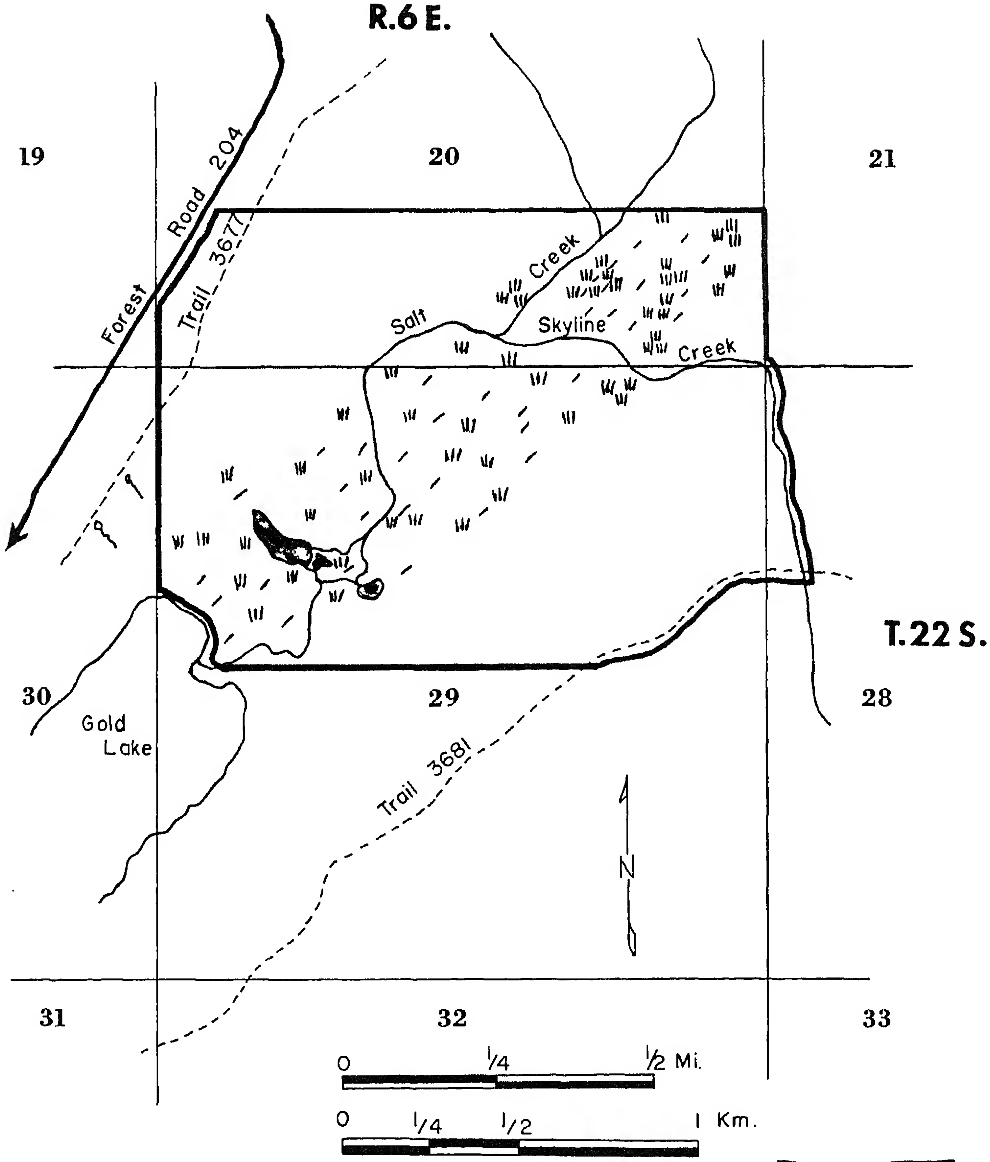
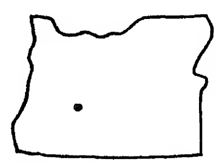
Table GL-1. — Tentative list of mammals for Gold Lake Bog Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Sorex bendirii	marsh shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Arborimus longicaudus	white-footed vole
	Castor canadensis	beaver
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus richardsoni	Richardson vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys mazama	Mazama pocket gopher
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Canis lupus	wolf
	Felis concolor	mountain lion or cougar
	Gulo luscus	wolverine
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Taxidea taxus	badger
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer
	Odocoileus h. columbianus	blacktail deer





LEGEND

BOUNDARY, GOLD LAKE BOG RESEARCH NATURAL AREA
SECTION LINE
STREAM
MARSH AND GRASSLAND
ROAD
TRAIL

Figure GL-1.– **Gold Lake Bog Research Natural Area, Lane County, Oregon.**

Figure GL-2.—Natural features of Gold Lake Bog Research Natural Area. Upper left: Typical bog community in which two species of *Drosera* and three of *Utricularia* are found. Upper right: Open forest association of Engelmann spruce and lodgepole pine typical of areas in and around the bogs and ponds. Center left and right: Ponds within the natural area showing typical subalpine mixed-conifer forests on surrounding slopes; note abundant water lilies. Lower left: Beaver dam within the Gold Lake Natural Area; the Oregon State Game Commission no longer removes such dams. Lower right: Beaver runways are common in some marshy areas.






Federal Research Natural Areas in Oregon and Washington—
A Guidebook for Scientists and Educators. 1972.
Pacific Northwest Forest and Range Experiment Station,
Portland, Oregon.

GOODLOW MOUNTAIN RESEARCH NATURAL AREA[1]

A tract spanning the transition from sagebrush steppe through open ponderosa pine savanna to ponderosa pine - white fir forest characteristic of south-central Oregon.

The Goodlow Mountain Research Natural Area was established May 1942 to exemplify the transition from sagebrush (*Artemisia* spp.) steppe through open ponderosa pine (*Pinus ponderosa*) savanna to ponderosa pine - white fir (*Abies concolor*) forest along an east-west elevational gradient. The 510-ha. (1,260-acre) tract is located in Klamath County, Oregon, and is administered by the Bly Ranger District (Bly, Oregon), Fremont National Forest. Its rectangular shape is oriented east and west (fig. GM-1) encompassing part of section 4, all of section 5, and part of section 6, T. 39 S., R. 13 E., Willamette meridian, at 45°10′ N. latitude and 121°15′ W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area is located about 71 km. (43 miles) east of Klamath Falls, Oregon. It is reached most readily by following State Highway 140 for 43.5 km. (27 miles) to Bonanza Junction at the foot of Bly Mountain; thence south for 3 km. (2 miles) on State Highway 70 to its junction with Forest Road 3726; thence east on Road 3726 for 11 km. (7 miles) to its junction with Forest Road 384; and south on Road 384 for 11 km. (7 miles) to the natural area. Although the tract can be reached from Bly, Oregon, the road is in very poor condition and should be avoided if possible.

ENVIRONMENT

The Goodlow Mountain Research Natural Area varies in elevation from 1,490 to 1,620 m. (4,900 to 5,300 ft.). Topography is gently rolling to rolling with slopes of 10 to 20 percent. Goodlow Mountain is a low butte at the edge of the sagebrush steppe. The natural area extends from the summit of Goodlow Mountain to the forest edge. The butte is igneous rock of volcanic origin.

A continental climate prevails. Most precipitation occurs as snow during the cool, partly cloudy winter. Summers are warm, generally low in precipitation, and largely cloudless. One to 3 months of drought are common. Climatic data from Round Grove located 29 km. (18 miles) east-northeast of the natural area are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	6.4°C. (43.5°F.)
Mean January temperature	-2.8°C. (27.0°F.)
Mean July temperature	16.8°C. (62.3°F.)
Mean January minimum temperature	-8.8°C. (16.1°F.)
Mean July maximum temperature	27.4°C. (83.1°F.)
Average annual precipitation	419 mm. (16.5 in.)
June through August precipitation	56 mm. (2.2 in.)
Average annual snowfall	119 cm. (47.0 in.)

Soils in the area have not been mapped. Reconnaissance notes suggest that, under forested stands, upper horizons contain aerially deposited pumice presumably from the Mount Mazama (now Crater Lake) eruption (Baldwin 1964). They tend to have minimum profile development and are not podzolized. Soils under juniper and sagebrush-grass appear to be derived from igneous rock.

[1] Description prepared by Dr. F. C. Hall, U.S. Department of Agriculture, Forest Service, Region 6, Portland, Oregon.

BIOTA

Estimated areas by plant community are as follows:

Community	*Area*
Pinus ponderosa/ Purshia tridentata savanna	89 ha. (220 acres)
Pinus ponderosa/ Arctostaphylos parryana	218 ha. (540 acres)
Pinus ponderosa-Abies concolor/ Carex rossii	130 ha. (320 acres)
Juniperus occidentalis/ Artemisia tridentata	40 ha. (100 acres)
Artemisia arbuscula/ Poa sandbergii	32 ha. (79 acres)

Pinus/Purshia and *Pinus/Arctostaphylos* stands are probably assignable to SAF forest cover type 237, Interior Ponderosa Pine (Society of American Foresters 1954), and Küchler's (1964) Type 10, Ponderosa Pine Shrub Forest. The *Pinus-Abies/Carex* stands are possibly assignable to SAF type 214, Ponderosa Pine - Western Larch - Douglas Fir, and to Küchler's Type 14, Grand Fir-Douglas Fir Forest, even though Douglas-fir is not present in this part of Oregon. *Juniperus/Artemisia* stands are assignable to SAF type 238, Western Juniper, and Küchler's Type 24, Juniper Steppe Woodland. The *Artemisia/Poa* stands are assignable to Küchler's Type 55, Sagebrush Steppe. The natural area spans upper elevation edges of sagebrush steppe, the ponderosa pine zone, and the lower edge of the white fir zone.

At lower elevations (1,490 m. or 4,900 ft.), *Juniperus/Artemisia* stands occur. These plant communities are dominated by western juniper (*Juniperus occidentalis*), big sagebrush (*Artemisia tridentata*), and Idaho fescue (*Festuca idahoensis*). The *Artemisia/Poa* stands occur on shallow to very shallow soils and reflect these edaphic restraints. They are dominated by low sagebrush (*Artemisia arbuscula*) and Sandberg bluegrass (*Poa sandbergii*). Soil conditions are inimical to both juniper and ponderosa establishment (fig. GM-2). Where soils are deeper, Idaho fescue tends to dominate.

A small meadow complex, about 1 ha. (2 acres) in size, occurs at the eastern edge of the natural area. It is unique in that a moist meadow is located topographically above a dry meadow.

The *Pinus/Purshia* stands are characteristic of the lowest forested elevations and represent savanna transitional to sagebrush steppe. They are dominated by ponderosa pine with a crown cover of 20 to 40 percent. Ground vegetation is generally dominated by bitterbrush (*Purshia tridentata*) and Ross's sedge (*Carex rossii*) with curlleaf mountain-mahogany (*Cercocarpus ledifolius*) and a variety of Compositae spp. as associates (fig. GM-2). Midelevations are characterized by ponderosa pine of 30- to 50-percent crown cover with Parry manzanita (*Arctostaphylos parryana*) and occasional bitterbrush with sedge (fig. GM-2). Upper elevations are characterized by old-growth ponderosa pine with seedlings, saplings, and poles, and occasionally mature trees of white fir. Tree crown cover ranges from 40 to 70 percent. Ground vegetation is dominated by Ross's sedge with minor amounts of Parry manzanita (fig. GM-2).

Mammals which frequent the natural area either as residents or transients are listed in table GM-1.

HISTORY OF DISTURBANCE

Fire scars on ponderosa pine (fig. GM-2) indicate ground fires periodically burned the area prior to initiation of fire control programs in 1910. Ranger District records document a ground fire between 1920 and 1930. In addition, a severe fire in 1918 (known as the Goodlow Mountain Burn) burned over 16 ha. (41 acres) of the southwestern corner of the natural area and killed 100 percent of the timber. A very dense stand of pine reproduction is now present in this area.

Prior to establishment of the natural area, an 800-ewe band of sheep grazed the tract periodically from the middle of June to the end of August. Ranger District records indicate this livestock use was light to moderate and should not have materially affected vegetation. Sheep use is now terminated.

RESEARCH

The Bureau of Entomology and Plant Quarantine has been studying bark beetle activity in section 5 since 1922. Between 1938 and 1940, two 10-acre plots were established in which all trees of 10-inch and larger d.b.h. were tagged, recorded, and fully described. These permanent plots are still under observation.

The Goodlow Mountain Research Natural Area provides interesting research opportunities on: (1) comparison of undisturbed vegetation across the geographic range of the aerially deposited Mount Mazama pumice in conjunction with Bluejay and Pringle Falls Research Natural Areas in the center and at the northern edge of the pumice deposit, respectively; (2) evaluation of environmental and plant community relationships from sagebrush steppe to mixed coniferous forest; (3) biomass productivity in relation to the environmental gradient; and (4) study of forest succession under fire prevention.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic maps are available for the natural area which are sufficiently detailed to be useful. Either the District Ranger (Bly Ranger District) or Forest Supervisor (Fremont National Forest, Lakeview, Oregon) can provide details on the most recent aerial photo coverage of the area.

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Table GM-1. — Tentative list of mammals for Goodlow Mountain Research Natural Area

Order	Scientific name	Common name
Insectivora	*Scapanus latimanus*	broad-footed mole
	Sorex merriami	Merriam shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus californicus*	black-tailed jack rabbit
	Sylvilagus nuttalli	mountain cottontail
Rodentia	*Erethizon dorsatum*	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Lagurus curtatus	sage vole
	Microtus montanus	mountain vole
	Neotoma cinerea	bushy-tailed wood rat
	Neotoma fuscipes	dusky-footed wood rat
	Peromyscus maniculatus	deer mouse
	Sciurus griseus	western gray squirrel
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus douglasi	chickaree
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mephitis mephitis	striped skunk
	Mustela frenata	long-tailed weasel
	Spilogale putorius	spotted skunk or civet cat
	Taxidea taxus	badger
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Odocoileus h. hemionus*	mule deer

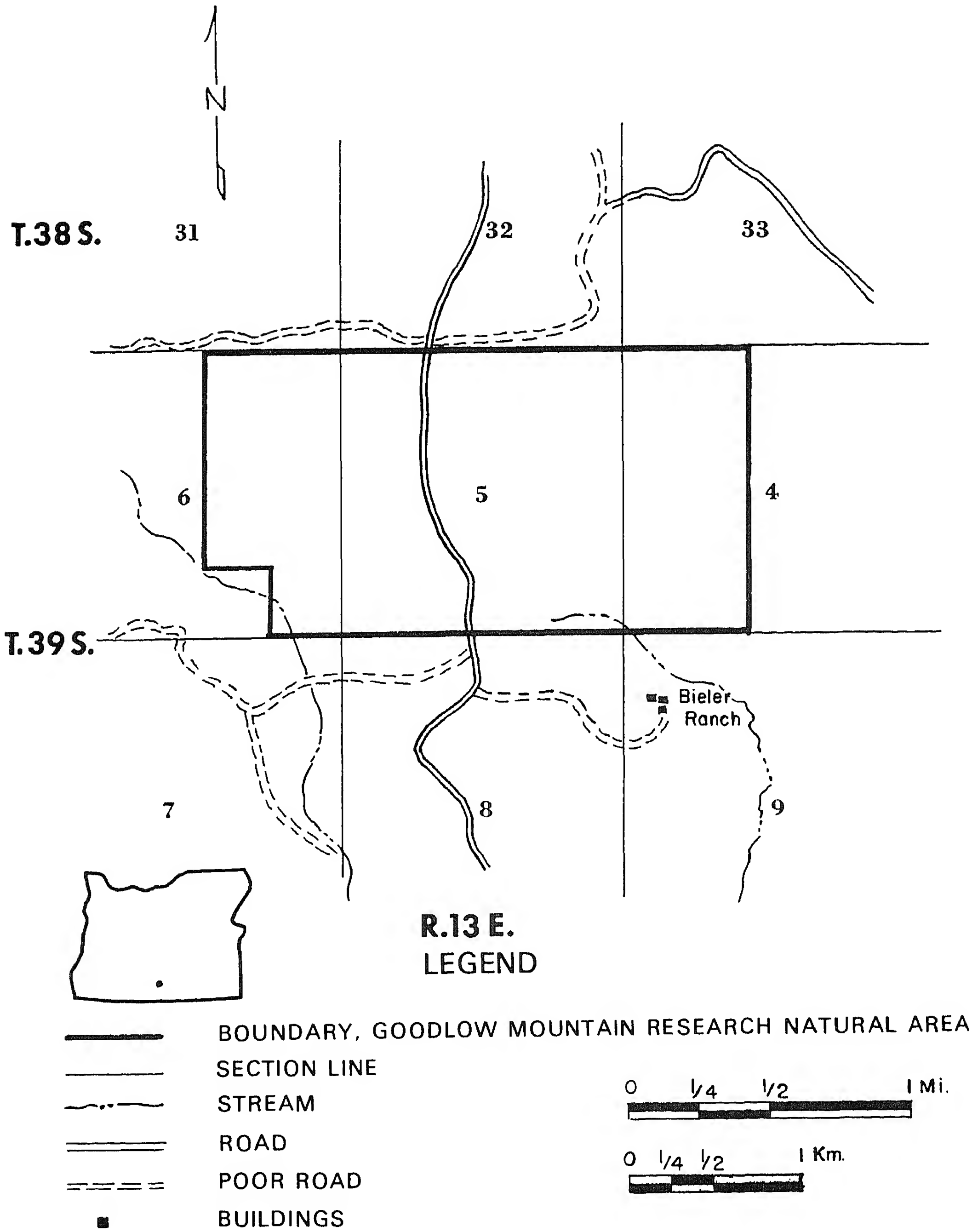

Figure GM-1.– Goodlow Mountain Research Natural Area, Klamath County, Oregon.

Figure GM-2.—Communities of the Goodlow Mountain Research Natural Area. Upper left: *Artemisia arbuscula/Poa Sandbergii* community with some Idaho fescue on shallow soil. Upper right: The *Pinus ponderosa/Purshia tridentata* community with some curlleaf mountain-mahogany is typical of lower elevations. Lower left: A *Pinus ponderosa/Arctostaphylos parryana* community typical of middle elevations. Lower right: *Pinus ponderosa-Abies concolor/Carex rossii* community characteristic of upper elevations; note fire scar on the tree left of the meter board.




HADES CREEK RESEARCH NATURAL AREA[1]

Pacific silver fir-western hemlock stands located at low elevations on the northwestern edge of the Olympic Peninsula.

The Hades Creek Research Natural Area was established to exemplify Pacific silver fir (*Abies amabilis*) - western hemlock (*Tsuga heterophylla*) forest as it occurs at lower elevations in the Olympic Mountains. The 227-ha. (560-acre) tract is located in Jefferson County, Washington, and is administered by Olympic National Park (Port Angeles, Washington). The natural area occupies the S1/2 and S1/2 NW1/4 of section 5 and N1/2 N1/2 of section 8, T. 27 N., R. 11 W., Willamette meridian. It lies at 47°52′ N. latitude and 124°09′ W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area is reached via the Bogachiel River Road (which leaves U.S. Highway 101 about 10 km. or 6 miles south of Forks) and the Bogachiel River Trail. The tract is located about 10 km. (6 miles) from the end of the road near the Bogachiel Shelter; it is necessary to ford the river about 1/4 mile above the shelter since it is on the north side of the river and the natural area is on the south. The natural area is located on slopes west of Hades Creek (fig. HA-1). An abandoned trail extends from the river to the summit of Spruce Mountain and traverses a large part of the natural area.

Commercial accommodations are, of course, quite remote, the nearest being located in the vicinity of Forks, which is several hours away by trail and road. There are numerous good camp spots along the Bogachiel River in the vicinity of the natural area. When camping in undeveloped areas, one must obtain a fire permit from the Park Service.

ENVIRONMENT

Hades Creek Research Natural Area occupies the top and slopes of a spur ridge on the lower slopes of Spruce Mountain and extends down to the benches along the Bogachiel River. Moderately steep slopes are typical except along the southern edge of the natural area, where the topography drops steeply into the drainage of Hades Creek. The gentlest slopes are found on the benches just above the Bogachiel River. Elevations in the natural area range from about 145 to 582 m. (475 to 1,910 ft.).

The natural area is located on upper Cretaceous - lower Tertiary sedimentary rocks belonging to the Soleduck formation (Huntting et al. 1961). This formation developed from marine sediments which were intensely folded and faulted and slightly metamorphosed (Danner 1955). The dominant, dark gray, massive to poorly bedded graywackes and sandstones are commonly interbedded with slate, argillite, and volcanic rock. The natural area was glaciated at least three times during the Wisconsin epoch and at least once even earlier (Crandell 1964).

A maritime climate, wet with muted temperature extremes, prevails. Winters are mild, and summers are cool with frequent cloudy days. Precipitation is heavy but highly seasonal, with January and December the peak months. Less than 10 percent of the annual

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

precipitation falls during June, July, and August, and some years a drought period of a month or more occurs. The following climatic data are from Forks, located about 19 km. (12 miles) to the northwest; temperatures are somewhat cooler and precipitation slightly higher on the natural area itself (U.S. Weather Bureau 1965):

Mean annual temperature	9.55°C.	(49.2°F.)
Mean January temperature	3.72°C.	(38.7°F.)
Mean July temperature	15.39°C.	(59.7°F.)
Mean January minimum temperature	0.17°C.	(32.3°F.)
Mean July maximum temperature	21.55°C.	(70.8°F.)
Average annual precipitation	2,974 mm.	(117.10 in.)
June through August precipitation	214 mm.	(8.44 in.)
Average annual snowfall	34 cm.	(13.7 in.)

The soils on the area have not been mapped or described. At least a portion would probably be classed as Sols Bruns Acides.

BIOTA

All 227 ha. (560 acres) of the natural area can be classified as SAF cover type 226, Pacific Silver Fir - Western Hemlock (Society of American Foresters 1954). The area would probably fall within Küchler's (1964) Type 3, Silver Fir - Douglas-fir Forest, and the *Tsuga heterophylla* Zone as defined by Franklin and Dyrness (1969). A zonal assignment is difficult for this area since it is occupied by forests which are more typically found at much higher elevations.

Pacific silver fir and western hemlock dominate the Hades Creek Research Natural Area. The relative proportion of the tree species varies considerably throughout the tract. For example, silver fir composes about 80 percent of the stand volume on the ridgetop but only 20 percent near Hades Creek on the south side of the area and on the north end. The bulk of the area varies from about a 60-40 to a 50-50 mixture of Pacific silver fir and western hemlock, respectively. Pacific silver fir within the natural area averages 75- to 90-cm. (30- to 35-in.) d.b.h. and 46 to 53 m. (150 to 175 ft.) in height. The largest known Pacific silver fir specimen, which is 56.7 m. (186 ft.) in height and about 208- cm. (82-in.) d.b.h. is located within the natural area (Pomeroy and Dixon 1966) (fig. HA-2). Occasional large, old-growth Douglas-fir (*Pseudotsuga menziesii*) and western redcedar (*Thuja plicata*) are also found throughout the natural area.

The major climax tree species within the natural area appears to be western hemlock. Seedlings and saplings of this species are typically much more common than those of Pacific silver fir, especially on drier sites. This is, of course, in direct contrast with the successional relationship between these species at middle and high elevations in the Olympic and Cascade Mountains (Fonda and Bliss 1969, Franklin and Dyrness 1969). Pacific silver fir is probably at least a minor climax species, as at least some reproduction of this species is present in most locations.

At least two major community types occur within the natural area: the *Tsuga heterophylla - Abies amabilis/Gaultheria shallon - Vaccinium parvifolium/Hylocomium splendens* and *Abies amabilis/Tsuga heterophylla/Maianthemum bifolium* communities. The *Tsuga/Gaultheria/Hylocomium* community is typical of lower elevations and drier slopes within the natural area. Understory plant species include: *Gaultheria shallon, Viola sempervirens, Acer circinatum, Blechnum spicant, Vaccinium parvifolium*, and *Eurhynchium oreganum*. The *Abies/Tsuga/Maianthemum* community appears to be typical of moister habitats within the natural area. The understory is dominated by herbaceous species such as *Maianthemum bifolium* var. *kamschaticum, Rubus pedatus, Oxalis oregana, Polystichum munitum, Disporum* sp., *Blechnum spicant, Tiarella trifoliata*, and *Trillium ovatum*.

Mammals believed to utilize the natural area either as residents or transients are listed in table HA-1.

Streams and streamsides are the only specialized habitats known to occur within the natural area.

HISTORY OF DISTURBANCE

There is no evidence of any unusual natural disturbance of the area during recent cen-

turies. Natural mortality such as that caused by windthrow is scattered throughout the tract.

Human disturbances to the natural area are very minor. An abandoned trail was constructed and used during World War II to supply an air-warning station on Spruce Mountain.

RESEARCH

Ten Pacific silver fir "trend plots" were established on the natural area in 1954 to observe annual mortality of Pacific silver fir and western hemlock, particularly that associated with the silver fir beetle (*Pseudohylesinus* spp.).[2] At the time of the first remeasurement in 1958, mortality of Pacific silver fir had been negligible (Buckhorn and Orr 1959).

The natural area provides interesting opportunities to study the ecology of low-elevation Pacific silver fir - western hemlock stands, e.g., the successional relationships between these tree species including variations associated with different types of microhabitats.

[2] "Silver fir beetles" is a local name given to two species of *Pseudohylesinus: P. grandis*, the grand fir bark beetle, and *P. granulatus*, the fir root bark beetle.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15' Spruce Mountain, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1956, and Olympic National Park and Vicinity, Washington, scale 1:125,000, issued by the U.S. Geological Survey in 1957; and *geology* — *Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). The Superintendent, Olympic National Park (Port Angeles, Washington), can provide details on the most recent aerial photo coverage and forest type maps for the area.

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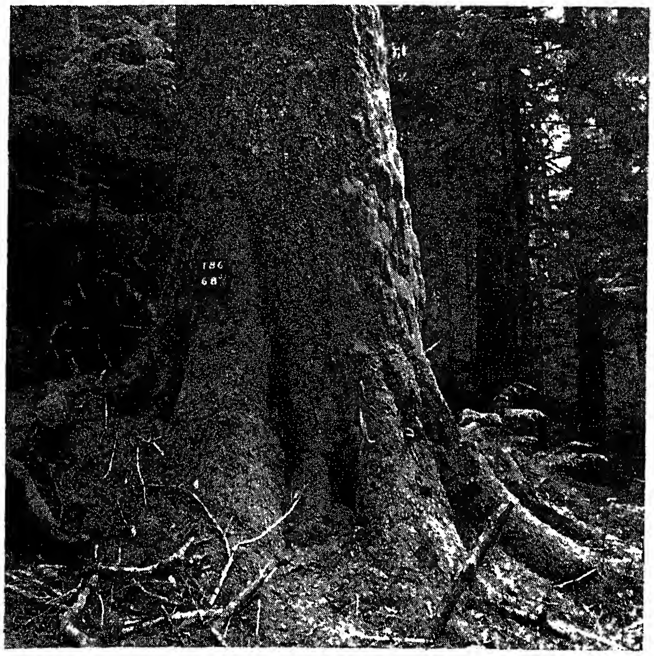
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis roosevelti*	Roosevelt elk
	Odocoileus h. columbianus	black-tailed deer

Figure HA-2.—Natural features of the Hades Creek Research Natural Area. Upper left: Base of largest known Pacific silver fir, 208-cm. (82-in.) d.b.h. and 56.7 m. (186 ft.) in height. Upper right: Upper stem and crown of same Pacific silver fir and its associates. Bottom: Typical mixed community of Pacific silver fir and western hemlock; the relatively sparse understory here is dominated by herbaceous plants.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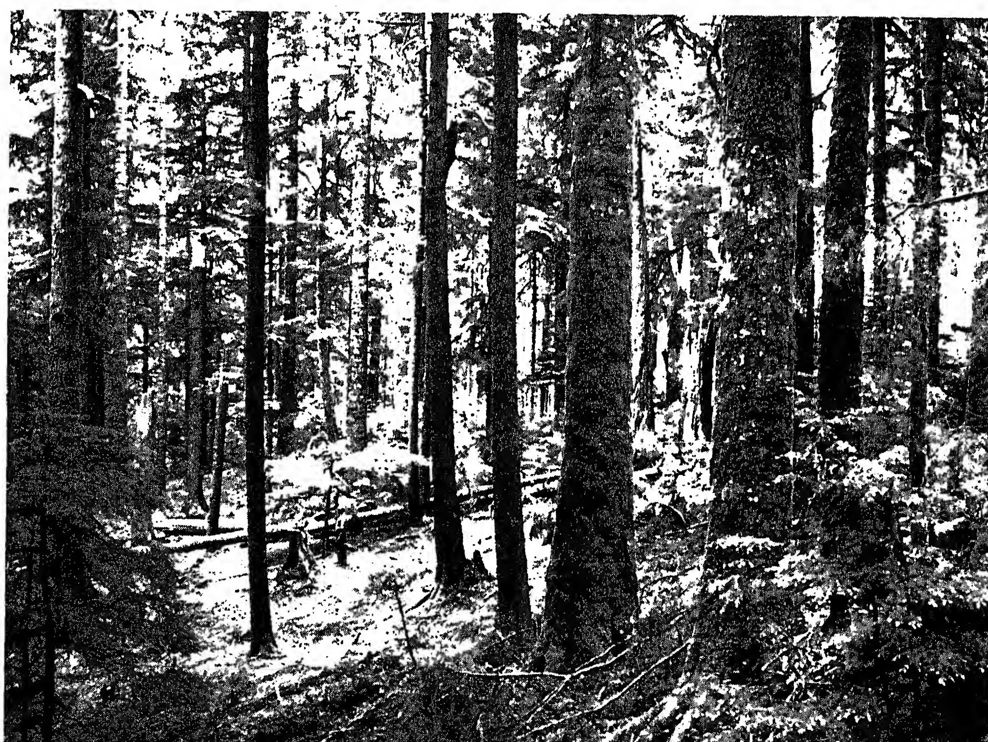

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Pacific Northwest Forest and Range Experiment Station,
Portland, Oregon.

HIGLEY CREEK RESEARCH NATURAL AREA[1]

Western hemlock stands on a mountain slope and valley bottom on the southwestern Olympic Peninsula.

The Higley Creek Research Natural Area was established to exemplify coastal western hemlock (*Tsuga heterophylla*) forest stands. The 194-ha. (480-acre) tract is located in Grays Harbor County, Washington, and is administered by the Olympic National Park (Port Angeles, Washington). The natural area occupies the S1/2 and the S1/2 N1/2, section 12, T. 23 N., R. 10 W., Willamette meridian. It lies at 47°30′ N. latitude and 123°54′ W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area is located near Lake Quinault and can be reached via U.S. Highway 101 (to Amanda Park) and the North Shore Road along the lake. The edge of the tract varies from 750 to 1,200 m. (2,500 to 4,000 ft.) north of this road. An abandoned trail leads up Higley Creek from this road skirting the natural area; its obscure terminus is located behind a house 2.7 km. (1.7 miles) from U.S. Highway 101 or 6.9 km. (4.3 miles) west of the National Park Service's Quinault Ranger Station. No roads or maintained trails enter the tract. Access is by cross-country travel.

Commercial accommodations, as well as several excellent public campgrounds, are located 3 to 8 km. (2 to 5 miles) from the natural area in the vicinity of Amanda Park and Quinault.

ENVIRONMENT

The Higley Creek Research Natural Area extends from the floor of the Quinault River valley onto the lower slopes of Higley Peak (fig. HI-1). Topography is gentle and undulating for 300 to 800 m. (1,000 to 2,500 ft.) from the southern boundary of the tract and then rises steeply to the northern boundary. The broken mountain slopes typically vary from 30 to 50 percent and have a generally southern exposure. Several streams flow through portions of the natural area, and several smaller streams rise within it. Drainages cut by these streams produce locally complex microtopography in the southern half of the tract. Elevations range from about 120 m. (400 ft.) in the southwestern corner to 550 m. (1,800 ft.) in the northwestern corner.

According to Huntting et al. (1961), higher elevations in the natural area are located on upper Cretaceous - lower Tertiary sedimentary rocks belonging to the Soleduck formation, while at lower elevations these rocks are covered by recent deposits of alluvium and, possibly, glacial drift. The Soleduck formation developed from marine sediments which have been intensely folded and faulted and slightly metamorphosed (Danner 1955). The dominant, dark gray, massive to poorly-bedded graywackes and sandstones are commonly interbedded with slate, argillite, and volcanic rock. The natural area was glaciated at least three times during the Wisconsin epoch and at least once before that (Crandell 1964).

A maritime climate, wet with muted temperature extremes, prevails. Winters are mild and summers are cool with frequent cloudy days. Precipitation is heavy but highly seasonal with January and December the peak months. Only about 7 percent of the annual

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

precipitation falls during June, July, and August; and some years a drought period of a month or more occurs. Snow is rare. Climatic data from the nearby Quinault Ranger Station are as follows (U.S. Weather Bureau 1956):

Mean annual temperature	10.6°C.	(51.0°F.)
Mean January temperature	3.8°C.	(38.9°F.)
Mean July temperature	17.3°C.	(63.2°F.)
Mean January minimum temperature	1.2°C.	(34.2°F.)
Mean July maximum temperature	23.8°C.	(74.9°F.)
Average annual precipitation	3,371 mm.	(132.73 in.)
June through August precipitation	244 mm.	(9.61 in.)
Average annual snowfall	30.2 cm.	(11.9 in.)

The soils on the area have not been mapped or described. In the valley bottom, they appear relatively deep and loamy, and on the mountain slopes they are somewhat shallower and contain greater amounts of loose rock. At least a portion of the soils would probably be classed as Sols Bruns Acides.

BIOTA

Essentially all 194 ha. (480 acres) of the natural area are occupied by SAF cover type 224, Western Hemlock (Society of American Foresters 1954). The area would probably fall entirely within Küchler's (1964) Type 1, Spruce - Cedar - Hemlock Forest, and contains elements of both the *Picea sitchensis* and *Tsuga heterophylla* Zones as defined by Franklin and Dyrness (1969).

Western hemlock is the most abundant tree within the research natural area, attaining diameters of 75 to 100 cm. (30 to 40 in.) b.h. and heights of 60 m. (200 ft.). Specimens up to 152-cm. (60-in.) d.b.h. and larger are occasionally encountered (fig. HI-2). Other coniferous tree species include western redcedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), Pacific silver fir (*Abies amabilis*), and Sitka spruce (*Picea sitchensis*). Western redcedar is most common in wet areas on gentle topography, where it may occur as very large (in excess of 254-cm. or 100-in. d.b.h.), old specimens. Douglas-fir is common as large, old trees, averaging 125- to 150-cm. (50- to 60-in.) d.b.h. with a maximum of about 203 cm. (80 in.). Both Pacific silver fir and Sitka spruce are rare, the former being encountered on the mountain slopes and the latter on the flat topography in the valley bottom. Red alder (*Alnus rubra*) is common along larger streams and in some swampy areas (fig. HI-2). Bigleaf maple (*Acer macrophyllum*) is also occasionally found on moist slopes or along streamsides.

Western hemlock is clearly the climax species throughout most of the natural area; it is the only species consistently represented by all age classes. Seedlings and saplings of hemlock are abundant; some stand openings are completely choked by sapling hemlocks. Reproduction of western redcedar, Douglas-fir, and Sitka spruce is generally absent. Much tree reproduction is found on rotting logs, "nurse logs," which often support hundreds of seedlings. Some of these can be expected to survive and their roots to reach mineral soil.

Four major community types were recognized within the natural area during the reconnaissance. These were (1) *Tsuga heterophylla/Polystichum munitum - Oxalis oregana*; (2) *Thuja plicata - Tsuga heterophylla/Vaccinium alaskaense - Gaultheria shallon/Blechnum spicant*; (3) *Tsuga heterophylla - Pseudotsuga menziesii/Gaultheria shallon - Vaccinium parvifolium*; and (4) an *Alnus rubra* swamp type. The most common community type is the *Tsuga/Polystichum - Oxalis* which is found both on mountain slopes and in the valley bottom. Typical understory species in this community include *Polystichum munitum*, *Oxalis oregana*, *Blechnum spicant*, *Tiarella trifoliata*, *Maianthemum bifolium* var. *kamschaticum*, *Galium triflorum*, and *Viola sempervirens*. The shrubby layer is not well developed, consisting primarily of *Vaccinium parvifolium*.

The *Thuja - Tsuga/Vaccinium - Gaultheria/Blechnum* community is found on relatively wet habitats and gentle topography. The shrubby layer in this community is dominated by *Vaccinium alaskaense* and *Gaultheria shallon*. Important herbs include *Blechnum spicant*, *Rubus pedatus*, *Cornus canadensis*, *Polystichum munitum*, *Gymnocarpium dryop-*

teris, Athyrium filix-femina, Tiarella trifoliata, and *Galium triflorum*.

The *Tsuga - Pseudotsuga/Gaultheria - Vaccinium* community is generally found on drier habitats on the slopes. Vine maple (*Acer circinatum*) is a common shrub dominant along with the *Gaultheria shallon*. Other shrubby species include *Berberis nervosa, Vaccinium parvifolium*, and *Rubus ursinus*. Herbaceous species may include *Polystichum munitum, Oxalis oregana, Trillium ovatum*, and *Viola sempervirens*.

Extremely wet or swampy areas on gentle topography are occupied by an open mosaic of tree, shrub, and herb-dominated stands (fig. HI-2). Red alder is the conspicuous tree species in such areas. These mosaics provide a rich variety of microhabitats for many plant and animal species not found elsewhere in the natural area. Plant dominants include the shrubs vine maple, *Gaultheria shallon, Rubus spectabilis, Menziesia ferruginea, Corydalis scoulariana, Stachys* sp., *Rhamnus purshiana*, and *Sambucus* sp. The rich selection of herbs includes *Athyrium filix-femina, Lysichitum americanum, Gymnocarpium dryopteris, Carex* spp., *Scirpus* sp., *Boykinia major, Cardamine* sp., and *Chrysosplenium glechomaefolium*, as well as several species of grass.

The Roosevelt elk (*Cervis canadensis roosevelti*) is the most important animal present on the natural area; their trails ease the problem of access through the area. Undoubtedly they have also affected the composition of the understory vegetation (Kirk 1966, Sharpe 1956). Mammals believed to occur within the natural area are listed in table HI-1.

Streams and streamsides are the only specialized habitats which are present. No lakes, ponds, rock outcrops, etc., exist within the natural area.

HISTORY OF DISTURBANCE

The most common natural disturbance encountered within the natural area is windthrow of trees, which may occur either singly or in small patches (fig. HI-2). There is no evidence of recent wildfires; fire scars can be seen on very old Douglas-firs. The parasitic dwarf mistletoe (*Arceuthobium campylopodum*) is commonly found on western hemlock within the natural area. Human disturbance within the natural area is essentially nonexistent.

RESEARCH

No research is presently known to be in progress within the natural area. Special research opportunities existing here include studies of contrasts in community composition and structure associated with variations in soils and topography, and effects of Roosevelt elk on their habitat.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Quinault Lake, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1955, and topographic map of Olympic National Park and Vicinity, Washington, scale 1:125,000, issued by the U.S. Geological Survey in 1957; and *geology* — *Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). The Superintendent, Olympic National Park (Port Angeles, Washington), can provide details on the most recent aerial photo coverage and forest type maps for the area.

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Table HI-1. — Tentative list of mammals for Higley Creek Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis roosevelti*	Roosevelt elk
	Odocoileus h. columbianus	black-tailed deer

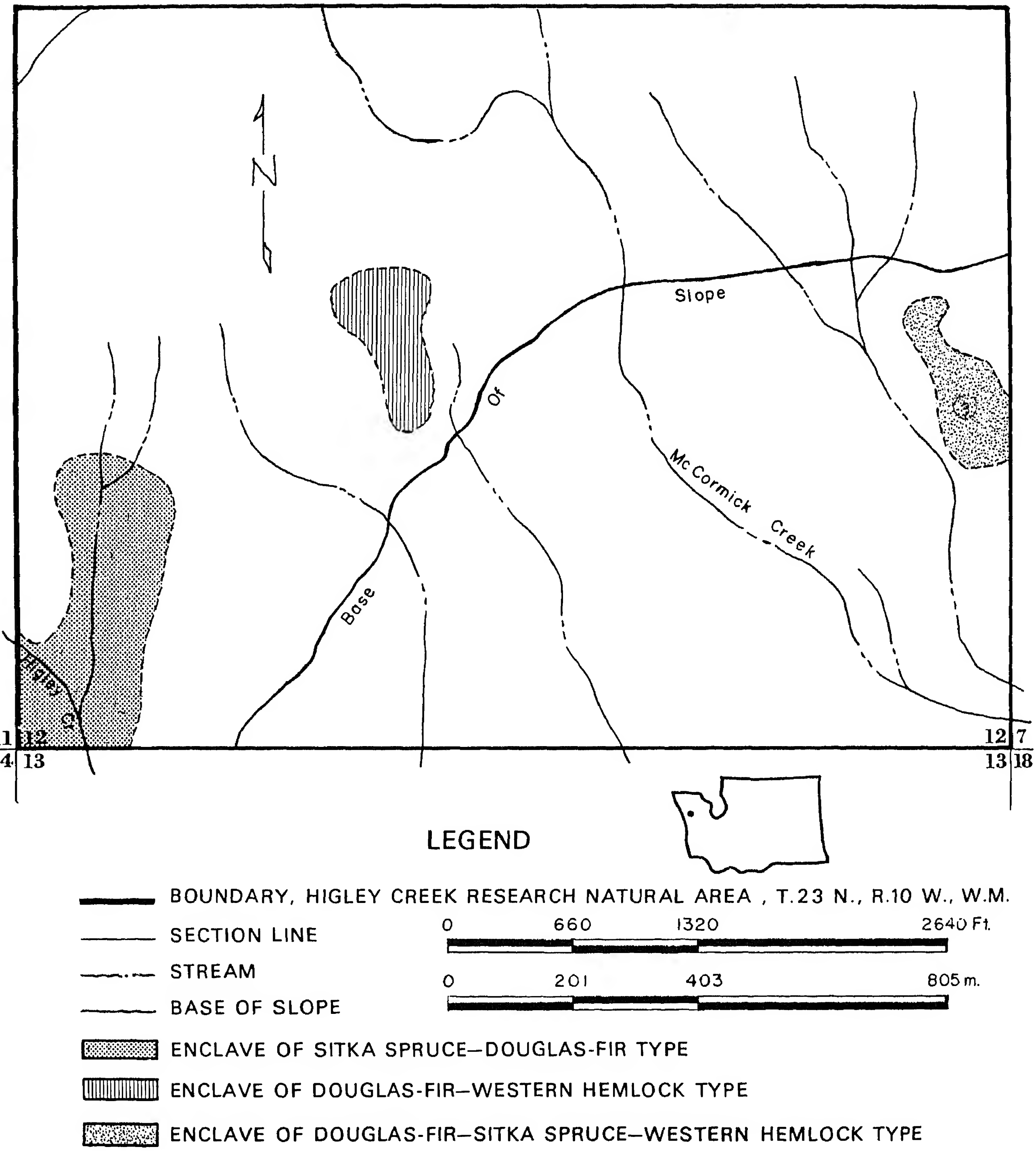
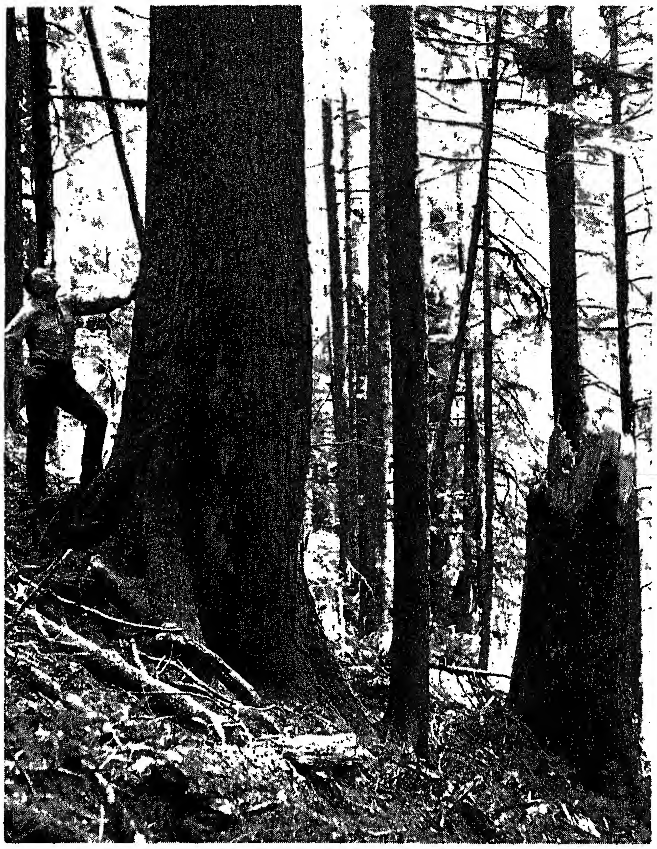
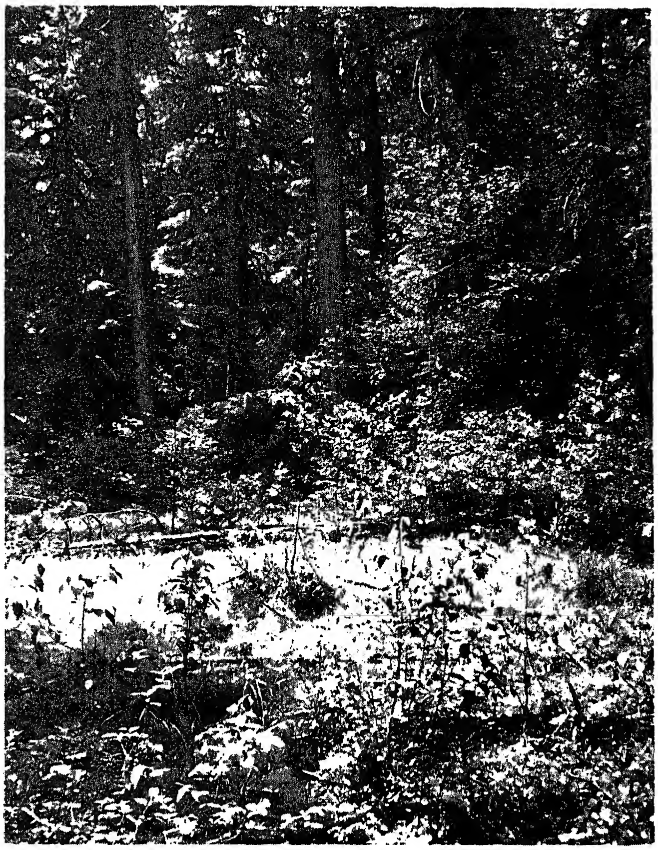


Figure HI-1.— Higley Creek Research Natural Area,
Grays Harbor County, Washington.

Figure HI-2.—Natural features of Higley Creek Research Natural Area. Upper left: Typical large western hemlock, with smaller hemlock in the background. Upper right: Swampy opening ringed with red alder. Bottom: Small patch of recently windthrown trees.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HORSE RIDGE RESEARCH NATURAL AREA[1]

A unique western juniper/big sagebrush/threadleaf sedge community in near pristine condition.

The Horse Ridge Research Natural Area was established March 1967 as an example of western juniper (*Juniperus occidentalis*) - big sagebrush (*Artemisia tridentata*) vegetation within the juniper zone of central Oregon. The 240-ha. (600-acre) tract is located in Deschutes County, Oregon, and is administered by the Prineville District (Prineville, Oregon), Bureau of Land Management. The rectangular tract is located in sections 15 and 22, T. 19 S., R. 14 E., Willamette meridian, at 43°55′ N. latitude, 120°02′ W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area is located about 31 km. (19 miles) southeast of Bend and is approached via U.S. Highway 20. Directions for locating the tract should be obtained at the Prineville District Office. Access is good during both summer and winter. Public accommodations are available in Bend; primitive camps which lack drinking water are available in the vicinity of the tract.

ENVIRONMENT

The Horse Ridge Research Natural Area varies in elevation from 1,250 to 1,430 m. (4,100 to 4,700 ft.). It is located on top of rolling topography (Horse Ridge) which rises above the surrounding flat to undulating plateau (fig. HR-2). Columbia River basalts underlie the entire area.

A continental climate prevails. Most precipitation occurs as snow during the cool, partly cloudy winter. Summers are warm, generally low in precipitation and largely cloudless. One to 4 months of drought are common. Climatic data from Bend are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	7.9°C. (46.3°F.)
Mean January temperature	-1.0°C. (30.2°F.)
Mean July temperature	17.6°C. (63.7°F.)
Mean January minimum temperature	-6.5°C. (20.3°F.)
Mean July maximum temperature	28.6°C. (83.6°F.)
Average annual precipitation	305 mm. (12.0 in.)
June through August precipitation	56 mm. (2.2 in.)
Average annual snowfall	91 cm. (36.0 in.)

Soils in the area have not been mapped. Cursory examination suggests they are sandy textured and developed in 30 to 60 cm. (12 to 24 in.) of aerially deposited pumice over well cracked basalt bedrock.

BIOTA

Nearly all of the 240 ha. (600 acres) is characterized by a western juniper/big sagebrush/threadleaf sedge (*Carex filifolia*) community. A small area at the eastern edge is occupied by a stand of western juniper/big sagebrush/bluebunch wheatgrass (*Agropyron spicatum*) with abundant surface stone. Vegetation can probably be assigned to SAF forest cover type 238, Western Juniper (Society of American Foresters 1954), and Küchler's (1964) Type 24, Juniper Steppe Woodland. The area falls within the *Juniperus occidentalis* Zone of central Oregon (Franklin and Dyrness 1969).

The major plant community (fig. HR-2) is dominated by western juniper which conspicuously lacks decadent or dead specimens.

[1] Description prepared by Dr. F. C. Hall, U.S. Department of Agriculture, Forest Service, Region 6, Portland, Oregon.

Ground vegetation is dominated by big sagebrush and threadleaf sedge with some dead and decadent bitterbrush (*Purshia tridentata*), bluebunch wheatgrass, Idaho fescue (*Festuca idahoensis*), *Koeleria cristata*, and *Tetradymia canescens*. The soil surface is characteristically bare of litter and is covered by fine pumice gravel, 2- to 5-mm. diameter.

This plant community is interesting in several ways. Hybridization of bluebunch wheatgrass and bottlebrush squirreltail (*Sitanion hystrix*) appears to be more common on this tract than elsewhere in the central Oregon juniper zone. Western juniper appears to affect distribution of plant species (fig. HR-2) — within the crown and root zone of western juniper, Idaho fescue tends to assume clear dominance to the near exclusion of big sagebrush and great reduction in threadleaf sedge. These conditions and the general dominance of threadleaf sedge tend to make this vegetation unique in the central Oregon area. Driscoll (1964) did not find this plant community common enough to warrant classification in his study of plant communities in central Oregon western juniper. Furthermore, this area apparently represents essentially ungrazed conditions; forage utilization data gathered by the Prineville District suggest that threadleaf sedge is sensitive to grazing and quickly decreases in abundance under heavy livestock use.

A list of mammals believed to utilize the natural area is provided in table HR-1. Mule deer (*Odocoileus hemionus*) are occasionally year around residents but frequently use the area for winter range.

HISTORY OF DISTURBANCE

An occasional burned-out juniper of large diameter can be found on the tract, indicating fires have occurred. Evidence of the extent of these fires could not be found. Normally only single trees are struck by lightning and burn, fires rarely spreading because of insufficient ground fuels.

Domestic livestock have apparently had little impact on the Horse Ridge Research Natural Area. Permanent water is a considerable distance below the ridge, suggesting that livestock have never been attracted to the area. As mentioned earlier, records in the Prineville District Office suggest livestock overuse causes a reduction in threadleaf sedge; the abundance of the sedge suggests minimal livestock disturbance. However, fencing may be necessary to prevent stock and increasing numbers of people from using the area.

RESEARCH

Baseline population levels of several bird and mammal species are presently under study on Horse Ridge Research Natural Area.[2] This is part of a larger, long-term eastern Oregon study which utilizes several other research natural areas in contrasting vegetation types. Research to date involves estimation of breeding bird populations based upon weekly, early-morning censuses during the breeding season within a 20-ha. (50-acre) grid and along a line transect.

The natural area provides interesting opportunities for research on: (1) hybridization of bluebunch wheatgrass with squirreltail and possibly native ryegrass (*Elymus* spp.); (2) evaluation of this unique plant community and the place of threadleaf sedge within the western juniper zone of central Oregon; and (3) evaluation of microchanges in herbaceous dominance as apparently influenced by juniper.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic maps are available for the natural area which are sufficiently detailed to be useful. The District Manager (Prineville District, Bureau of Land Management) can provide details on the most recent aerial photo coverage of the area.

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[2] Research by Jay S. Gashwiler, Bureau of Sport Fisheries and Wildlife, Silviculture Laboratory, Bend, Oregon.

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Figure HR-2.—Communities of the Horse Ridge Research Natural Area. Upper left: A western juniper/big sagebrush/threadleaf sedge community with some bluebunch wheatgrass and Idaho fescue typical of those occupying the majority of the natural area. Upper right: General northwesterly view from west end of tract showing typical western juniper woodland. Lower left: Close view of ground vegetation dominated by big sagebrush and threadleaf sedge. Lower right: A view illustrating the apparent influence of western juniper on the distribution of ground vegetation—Idaho fescue dominates near the tree; big sagebrush and threadleaf sedge are common around the periphery.




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JACKSON CREEK RESEARCH NATURAL AREA[1]

An old-growth Douglas-fir stand growing on a major river terrace in the western Olympic Peninsula.

The Jackson Creek Research Natural Area was established to exemplify the Douglas-fir (*Pseudotsuga menziesii*) forest type as it occurs on the western Olympic Peninsula. The 65-ha. (160-acre) tract is located in Jefferson County, Washington, and is administered by the Olympic National Park (Port Angeles, Washington). The natural area is rectangular occupying the NE¼ NE¼ section 13, T. 27 N., R. 10 W., and N½ NW¼ and NW¼ NE¼ section 18, T. 27 N., R. 9 W., Willamette meridian (fig. JC-1). It lies at 47°51′ N. latitude and 123° 55′ W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area is located on the south bank of the Hoh River immediately opposite the Hoh River Ranger Station and campground. The ranger station is at the end of the Hoh River Road about 30 km. (19 miles) from U.S. Highway 101. To reach the natural area, it is necessary to ford the Hoh River. This generally requires scouting up river from the campground until a log jam suitable for crossing is located. During recent years, such a log jam has been located only a short distance above the central campground area, but conditions change periodically. Although there are no trails, cross-country travel within the natural area is not difficult because of the open nature of the forest stand.

Commercial accommodations are available in Forks or Kalaloch, along U.S. Highway 101, from 48 to 64 km. (30 to 40 miles) away. However, the public campground at the end of the Hoh River Road is excellent, and there are several smaller state campgrounds along the road outside of the Park.

ENVIRONMENT

The natural area occupies gentle topography on terraces and benches in the Hoh River valley. Elevations range from about 207 to 402 m. (680 to 1,320 ft.). Jackson Creek flows through the middle of the natural area. The natural area is located on upper Cretaceous-lower Tertiary sedimentary rocks belonging to the Soleduck formation (Danner 1955, Huntting et al. 1961). However, bedrock is buried entirely beneath depositions of alluvium and, possibly, glacial drift at higher elevations. The valley of the Hoh River, including the natural area, was glaciated at least three times during the Wisconsin epoch and at least once before that (Crandell 1964).

A wet, mild, maritime climate prevails. Winters are mild, and summers are cool with frequent cloudy days. Precipitation is heavy, but less than 10 percent falls during summer months. The following climatic data are from the Forks Weather Station located approximately 35 km. (22 miles) northwest of the natural area (U.S. Weather Bureau 1965):

Mean annual temperature	9.55°C.	(49.2°F.)
Mean January temperature	3.72°C.	(38.7°F.)
Mean July temperature	15.39°C.	(59.7°F.)
Mean January minimum temperature	0.17°C.	(32.3°F.)
Mean July maximum temperature	21.55°C.	(70.8°F.)

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

Average annual precipitation	2,974 mm. (117.10 in.)
June through August precipitation	214 mm. (8.44 in.)
Average annual snowfall	348 cm. (13.70 in.)

Precipitation is significantly higher on the natural area itself, probably averaging about 3,600 mm. (142 in.) annually (Kirk 1966).

Soils appear to be predominantly Sols Bruns Acides. Fonda[2] has described profiles with A1-B1-B2-C sequences from terraces in the vicinity of the natural area. The A1 horizons are apparently relatively thick (0 to 16 cm.).

BIOTA

Essentially all 65 ha. (160 acres) of the natural area can be classified as SAF forest cover type 229, Pacific Douglas-Fir (Society of American Foresters 1954). It would probably fall entirely within Küchler's (1961) Type 1, Spruce-Cedar-Hemlock Forest, and the *Picea sitchensis* Zone as defined by Franklin and Dyrness (1969).

Four coniferous tree species are known to occur within the Jackson Creek Research Natural Area: Douglas-fir, western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), and western redcedar (*Thuja plicata*). Douglas-fir is overwhelmingly dominant, surprisingly so for a stand estimated to be around 275 years in age. Samples within the natural area indicate about 72 sq. m. per hectare of basal area (314 sq. ft. per acre), of which 87 percent is Douglas-fir.[3] Trees average 125- to 150-cm. (50- to 60-in.) d.b.h. and 68 m. (225 ft.) in height with maximum diameters of about 235 cm. (94 in.) b.h. (fig. JC-2). Western hemlock is well distributed over the natural area, but averages only about 11 percent of the stand volume. Western hemlock has relatively little representation in intermediate size classes (saplings and poles). Sitka spruce is generally uncommon in the overstory but is commonly encountered as reproduction growing on down logs; it is most common in swampy areas found in some portions of the natural area. Occasional red alder (*Alnus rubra*) and bigleaf maple (*Acer macrophyllum*) may also be encountered in the wetter, open areas.

The major climax species on the natural area appears to be western hemlock, although age class distributions indicate the climax condition is still far in the future. Sitka spruce may also be a minor climax species in these forests, since reproductive size classes up to saplings and small poles are encountered through most of the area. Climax status for the Sitka spruce would apparently contrast with normal conditions for the *Picea sitchensis* Zone (Franklin and Dyrness 1969). This is probably a partial consequence of the special conditions found in so-called "rain forest" valleys of the western Olympic Peninsula, e.g., the relatively open nature of many of the stands and selective grazing of hemlock seedlings by elk.[4]

Several community types can be recognized within the natural area including: (1) *Pseudotsuga menziesii/Pteridium aquilinum-Achlys triphylla*, (2) *Pseudotsuga menziesii/Polystichum munitum-Oxalis oregana*, *(3) Picea sitchensis/Acer circinatum/Pteridium aquilinum*. The *Pseudotsuga/Pteridium-Achlys* community occupies much of the actual river-terrace habitat within the natural area (fig. JC-2). Typical species include *Pteridium aquilinum*, *Oxalis oregana*, *Tiarella trifoliata*, *Vaccinium parvifolium*, *Achlys triphylla*, *Rubus pedatus*, *Blechnum spicant*, *Luzula parviflora*, *Trisetum cernuum*, *Carex deweyana*, and *Maianthemum bifolium* var. *kamschaticum*. The *Pseudotsuga/Polystichum-Oxalis* community is very similar in composition, lacking only the dominance of *Pteridium aquilinum*. This community type is most common in the eastern half of the natural area on gentle slopes and a higher level bench. The *Picea/Acer/Pteridium* community typifies the very open areas which appear relatively swampy in character. Tree cover is very low in these openings, but the coverage of brush species such as vine maple (*Acer circinatum*) and herbs such as *Pteri-*

[2] Personal communication from Dr. Richard W. Fonda, Biology Department, Western Washington State College, Bellingham.

[3] See footnote 2.

[4] See footnote 2.

dium aquilinum and various grasses and sedges is quite high.

The most important mammal within the natural area is the Roosevelt elk (*Cervus canadensis roosevelti*) which is particularly common during the winter and spring. A list of mammals believed to utilize the tract is provided in table JC-1.

Jackson Creek, which flows through the natural area for a small portion of its length, provides the only aquatic habitat within the natural area. The open swampy areas undoubtedly provide additional specialized habitat for a variety of plant and animal species not typical of the heavily forested area.

HISTORY OF DISTURBANCE

The Douglas-fir stand present on the natural area probably originated with a wildfire approximately three centuries ago; however, no fire scars were seen, which would provide evidence for more recent wildfires.

Human disturbance of the area appears to be very minor despite its proximity to the Hoh River campground; the Hoh River undoubtedly provides a major barrier against casual use of the area.

RESEARCH

The only research work known to have been conducted within the natural area is an examination and description of the Douglas-fir stands in connection with a study of the relationship between forest communities and environmental conditions in the Hoh River valley.[5] The natural area would appear to offer unusually good opportunities for studies of: (1) successional development and the factors which have retarded the rate of natural succession from Douglas-fir to hemlock; (2) the effect of Roosevelt elk on community composition and forest succession; and (3) occurrence of animals in sharply contrasting but contiguous community types (dense Douglas-fir forest vs. wet, brush- and herb-dominated openings).

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography*—15′ Mount Tom, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1955, and Olympic National Park and Vicinity, Washington, scale 1:125,000, issued by the U.S. Geological Survey in 1957; and *geology*—*Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). The Superintendent, Olympic National Park (Port Angeles, Washington), can provide details on the most recent aerial photo coverage and forest type maps for the area.

[5] See footnote 2.

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Table JC-1. — Tentative list of mammals for Jackson Creek Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis roosevelti*	Roosevelt elk
	Odocoileus h. columbianus	black-tailed deer

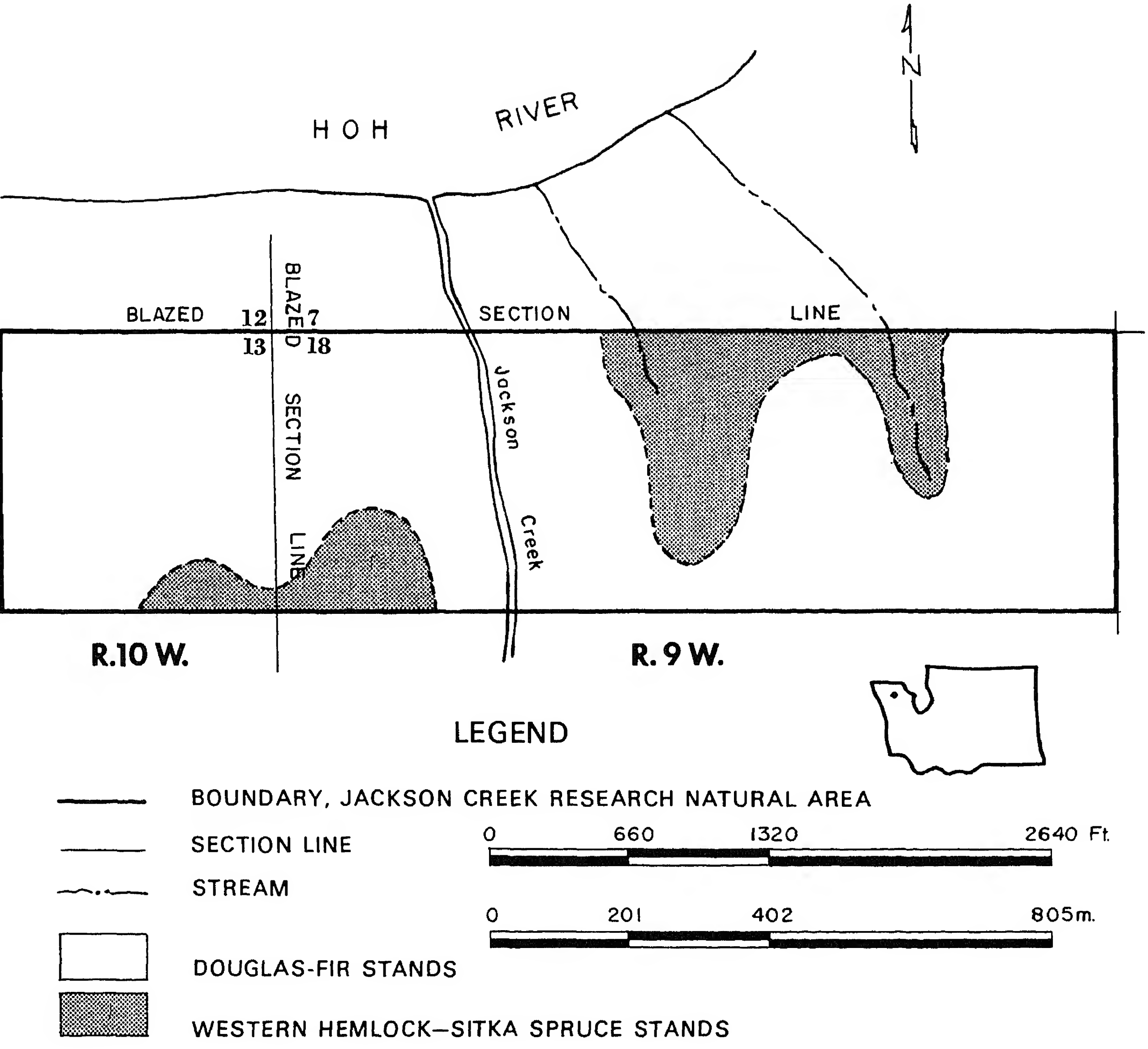
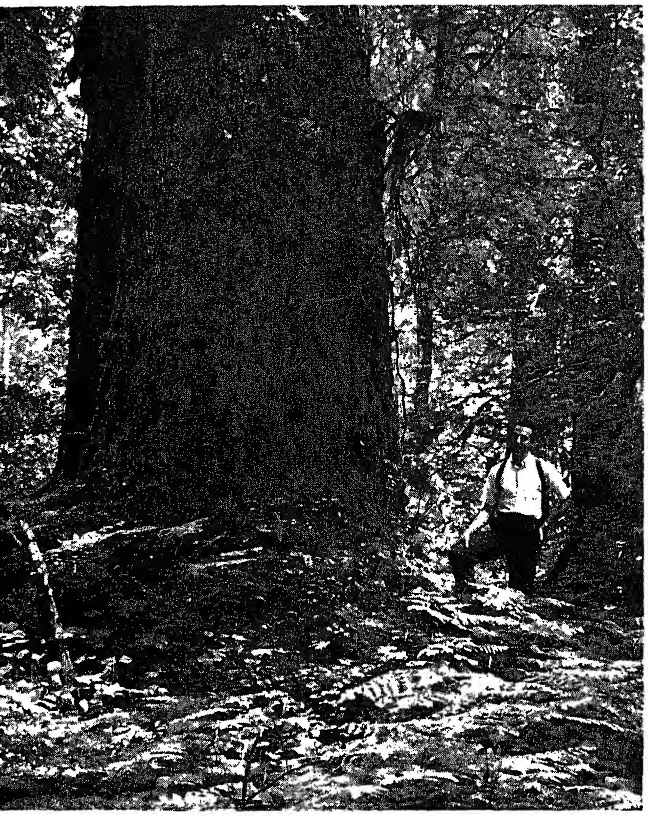
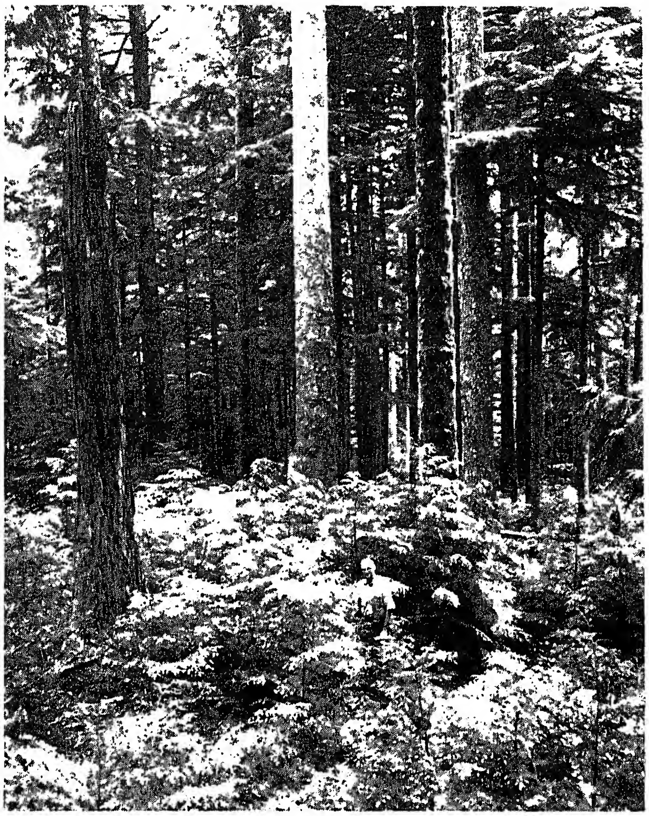


Figure JC-1.– **Jackson Creek Research Natural Area, Jefferson County, Washington.**

Figure JC-2.—Communities of the Jackson Creek Research Natural Area. Upper left: Old-growth specimen of Douglas-fir approximately 235-cm. (94-in.) d.b.h. Upper right: Ecotone between the Douglas-fir stands and a swampy, open area dominated by shrubs and herbs; reproduction of western hemlock is conspicuous. Bottom: Typical terrace community of *Pseudotsuga menziesii/ Pteridium aquilinum-Achlys triphylla* on the main river terrace within the natural area.


Federal Research Natural Areas in Oregon and Washington—
A Guidebook for Scientists and Educators. 1972.
Pacific Northwest Forest and Range Experiment Station,
Portland, Oregon.

LAKE TWENTYTWO RESEARCH NATURAL AREA[1]

"Subalpine" lake and old-growth western redcedar - western hemlock forest on a rugged mountain slope in the northern Cascades of Washington.

The Lake Twentytwo Research Natural Area was established on January 14, 1947, as a sample of virgin old-growth western redcedar (*Thuja plicata*) - western hemlock (*Tsuga heterophylla*) forest. The 320-ha. (790-acre) tract is located in Snohomish County, Washington, and is administered by the Monte Cristo Ranger District (Granite Falls, Washington), Mount Baker National Forest. It includes: section 22 (except NW1/4 and W1/2 SW1/4), W1/2 SW1/4, SW1/4 NW1/4, and S1/2 NW1/4 NW1/4 of section 23; and NE1/4 and E1/2 NW1/4 of section 27, T. 30 N., R. 8 E., Willamette meridian (fig. LA-1). It lies at 48°04′ N. latitude and 121°46′ W. longitude.

ACCESS AND ACCOMMODATIONS

Access to the vicinity is via U.S. Highway 2 and State Highways 9 and 92 from Everett to Granite Falls and Forest Highway 7 to Verlot Ranger Station. Beyond the ranger station, follow Forest Highway 7 for 2.9 km. (1.8 miles) to the start of the Lake Twentytwo Trail.

The Lake Twentytwo Trail lies almost entirely within the natural area and traverses a large part of it. The trail climbs for 4 km. (2.5 miles) and 425 m. (1,400 ft.) of elevation to its terminus at the lake. There are no other trails or roads within the natural area boundary, and cross-country access to that part of the tract east of Twentytwo Creek and Twentytwo Lake is difficult.

The nearest commercial overnight accommodations are in Everett about 40 km. (25 miles) away, although food can be obtained at Verlot and Granite Falls. There are seven public campgrounds with 3 to 8 km. (2 to 5 miles) of the natural area.

ENVIRONMENT

The Lake Twentytwo Research Natural Area occupies essentially the entire drainage of Lake Twentytwo Creek except for some of the rugged cliffs and rock ridges south and west of Lake Twentytwo. Elevations range from about 335 m. (1,100 ft.) above sea level near the South Fork of the Stillaguamish River to about 1,100 m. (3,600 ft.) on the ridges southeast and west of Lake Twentytwo. Topography is steep to very steep and broken; a few small benches are present.

Lake Twentytwo lies entirely within the natural area. It is a 17.9-ha. (44.1-acre) lake with a maximum measured depth of 16 m. (53 ft.) (Wolcott 1961). The lake was created by glacial activity. Despite its location at a relatively low elevation of 750 m. (2,460 ft.), the lake and its environs have many aspects of a much higher subalpine lake; permanent snowfields are found within the lake basin (fig. LA-2).

The natural area is located on two major geologic formations (Huntting et al. 1961). Rocks in the upper part of the natural area are granitic intrusive rocks of Tertiary - Cretaceous age, while those at lower elevation are upper Jurassic - lower Cretaceous sedimentary rocks. The cirque basin in which Lake

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

Twentytwo is located, as well as the lake itself, are obviously glacial features which originated during the Pleistocene.

The natural area is subject to a wet, cool, maritime climate. Annual precipitation is heavy and highly seasonal, although rain is not uncommon during the summer months. Summers are cool. This regional cool, wet climate is, of course, accentuated on the steep north slope occupied by the natural area. Climatic data from the nearest weather bureau station — Darrington, Washington, about 24 km. (15 miles) northeast — are as follows (U.S. Weather Bureau 1956, 1965). They probably approximate climatic conditions encountered at lower elevations in Lake Twentytwo Research Natural Area:

Mean annual temperature	9.6°C. (49.4°F.)
Mean January temperature	1.1°C. (33.9°F.)
Mean July temperature	17.4°C. (63.3°F.)
Mean January minimum temperature	-3.2°C. (26.1°F.)
Mean July maximum temperature	25.9°C. (78.7°F.)
Average annual precipitation	2,045 mm. (80.51 in.)
June through August precipitation	155 mm. (6.06 in.)
Average annual snowfall	120 cm. (47.4 in.)

Soils on the natural area have recently been mapped by U.S. Forest Service personnel as part of a soil survey of the Mount Baker National Forest (Snyder and Wade 1970). Most of the higher elevational area surrounding Lake Twentytwo is shown on the map as talus slopes and intrusive igneous rock outcrop areas. In the eastern, midelevation portion of the area soils are derived from metasedimentary rocks and are classed as coarse loamy, mixed Typic Ferrods. These soils have a dark reddish brown loam surface layer which is underlain at about 55 cm. (22 in.) by dark yellowish brown very gravelly loam. The more gently sloping low elevational areas near the northern boundary are occupied by three soil units derived from glacial drift material. These soils have been classified as a Typic Ustifluvent, Typic Ustipsamment, and a Typic Fragiorthod. Typically these soils have a brown gravelly loam surface and are underlain at varying depths by very gravelly loamy sand.

BIOTA

A gross estimate of areas by SAF forest types (Society of American Foresters 1954) is as follows:

No.	*Name*	*Area*
227	Western Redcedar - Western Hemlock	184 ha. (455 acres)
226	Pacific Silver Fir - Hemlock	32 ha. (80 acres)
228	Western Redcedar	16 ha. (40 acres)
221	Red Alder	10 ha. (25 acres)

Much of the acreage of Pacific silver fir - hemlock type is composed of small patches and stringers of trees. In addition to the areas classed as forest, there are approximately 30 ha. (75 acres) of brushfields, 28 ha. (70 acres) of "barrens" — cliffs, meadows, and talus — and 18 ha. (45 acres) of water within the natural area. Küchler's (1964) Types 2 (Cedar-Hemlock-Douglas Fir Forest), 3 (Silver Fir - Douglas Fir Forest), 4 (Fir - Hemlock Forest), 25 (Alder - Ash Forest), and 52 (Alpine Meadows and Barren) are represented within Lake Twentytwo Research Natural Area. The natural area spans both the *Tsuga heterophylla* and *Abies amabilis* Zones of Franklin and Dyrness (1969) and includes many elements of the *Tsuga mertensiana* Zone in the lake basin.

The lower forests in the natural area are old-growth stands of western hemlock and western redcedar. Some Pacific silver fir (*Abies amabilis*) are present as well as an occasional Sitka spruce (*Picea sitchensis*) at lowest elevations. The largest trees are the redcedar which average 1.5 to 2.5 m. (5 to 8 ft.) in diameter (fig. LA-2), with a maximum of nearly 3.7-m. (12-ft.) d.b.h. Hemlocks of all ages and sizes up to 130-cm. (50-in.) d.b.h. are present. Western hemlock appears to be the climax species, as reproduction of western redcedar is generally absent and that of Pacific silver fir is sporadic at low elevations. The understory can be typified by *Vaccinium alaskaense, V. ovalifolium, Menziesia ferruginea, Blechnum spicant, Cornus canadensis, Rubus pedatus, Spaghnum girgensohnii,* and *Hylocomium splendens.* In wetter locations, e.g., along streams, *Oplopanax horridum,*

Athyrium filix-femina, *Rubus spectabilis*, *Tolmeia menziesii*, *Ribes bracteosum*, and *Boykinia major* are conspicuous.

Forests at higher elevations are characterized by Pacific silver fir, mountain hemlock (*Tsuga mertensiana*), and Alaska-cedar (*Chamaecyparis nootkatensis*). In older stands, the trees average 75- to 100-cm. (30- to 40-in.) d.b.h. The climax species appears to be silver fir, as reproduction of the others is sparse. A dense layer of shrubs is usually present, including *Vaccinium alaskaense*, *V. ovalifolium*, *Menziesia ferruginea*, *Rubus spectabilis*, and *Cladothamnus pyrolaeflorus*. Dominant herbs are *Streptopus curvipes*, *Rubus pedatus*, *Blechnum spicant*, and *Maianthemum bifolium* var. *kamschaticum*.

Another major group of communities is brushfield stands; these vary in character depending on local moisture and temperature conditions. One type, conspicuous along the Lake Twentytwo Trail, is dominated by vine maple (*Acer circinatum*); it is found on scree slopes. Many other shrubs are present, such as *Rubus spectabilis*, Sitka alder (*Alnus sinuata*), *Sambucus* sp., *Ribes lacustre*, and *Oplopanax horridum*. The rich herb layer usually includes *Athyrium filix-femina*, *Pteridium aquilinum*, *Cryptogamma acrostichoides*, *Montia* spp., *Aruncus sylvester*, *Galium* sp., and *Tolmeia menziesii*. A part of one vine maple-dominated brushfield includes a small stand of bigleaf maple (*Acer macrophyllum*) 20- to 25-cm. (8- to 10-in.) d.b.h. (fig. LA-2).

The cirque basin occupied by Lake Twentytwo is a mosaic of habitats and communities, mostly nonforested (fig. LA-2). Habitats include wet rocky cliffs, margins of permanent snowpatches, boulder fields, scree slopes, and alluvial deposits along the lake shore; all are supplied with abundant moisture. The communities include: a variety of dense herbaceous stands dominated by species such as *Polygonum bistortoides*, *Athyrium americanum*, *Carex* spp., *Veratrum viride*, *Valeriana sitchensis*, and *Caltha* sp.; dense shrub fields dominated by *Vaccinium ovalifolium*, *V. alaskaense*, *Menziesia ferruginea*, *Sorbus* sp., and *Cladothamnus pyrolaeflorus*; and patches of mostly small Pacific silver fir, mountain hemlock, and Alaska-cedar. Most communities have a distinctly subalpine aspect despite the 760-m. (2,500-ft.) elevation; *Phyllodoce empetriformis* and *Luetkea pectinata*, timberline species, are found along the lakeshore.

A variety of fauna inhabit the natural area. A list of mammals believed to utilize the tract as residents or transients is provided in table LA-1. Fish were planted in Lake Twentytwo over 30 years ago; Wolcott (1961) indicates rainbow trout were planted in 1951.

The specialized terrestrial habitats have already been mentioned, e.g., the cliffs, snowpatches, and scree slopes of the lake basin. There is also the lake itself and the entire length of Twentytwo Creek (fig. LA-2).

HISTORY OF DISTURBANCE

The Lake Twentytwo area has a long history of public use and human disturbance is evident in a few locations. At one time there was a YMCA camp on the shore of the lake; it was abandoned and the debris removed prior to establishment of the natural area. The original trail to the lake closely followed the creek. It was abandoned when the present trail was completed but is still evident in some locations. At present the most obviously disturbed areas are around the lake, especially at the north end, where campers, hikers, and fishermen have created bare openings and a system of trails. Recreational use of the trail and lake margins is heavy and continuing.

There is no evidence of wildfire within the natural area, and none have been recorded within historic times.

RESEARCH

No research is presently being conducted within the natural area. Some unique research opportunities would include (1) comparison of the forests of Lake Twentytwo Research Natural Area with those on the south-facing Long Creek Research Natural Area 3 km. (2 miles) away, and (2) study of the relationships between plant and animal communities and the environmental mosaic within the Lake Twentytwo basin.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Granite Falls, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1956; and *geology* — *Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). Either the District Ranger (Monte Cristo Ranger District) or Forest Supervisor (Mount Baker National Forest, Bellingham, Washington) can provide details on the most recent aerial photo coverage and forest type maps for the area.

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Table LA-1. — Tentative list of mammals for Lake Twentytwo Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex cinereus	masked shrew
	Sorex obscurus	dusky shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
	Ochotona princeps	pika
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Orégon or creeping vole
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus saturatus	Cascades mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer
	Oreamnos americanus	mountain goat

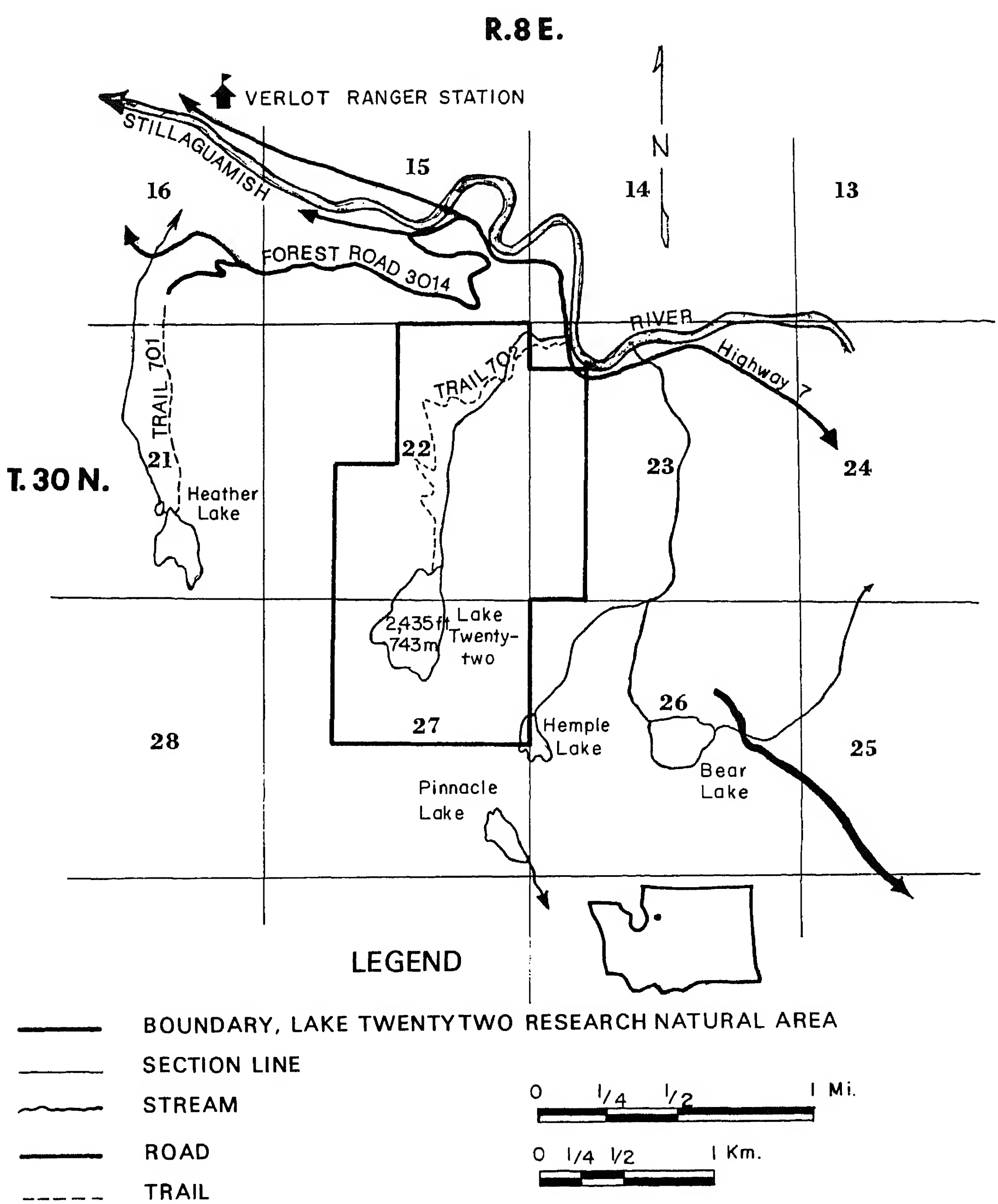
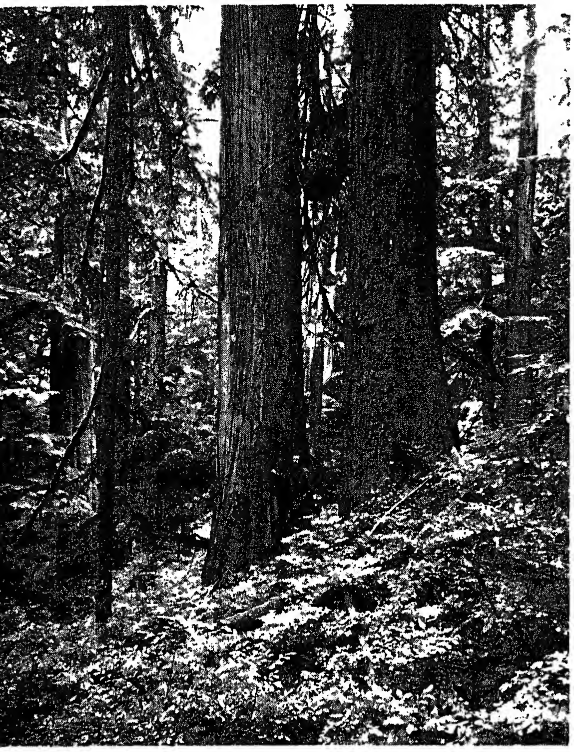
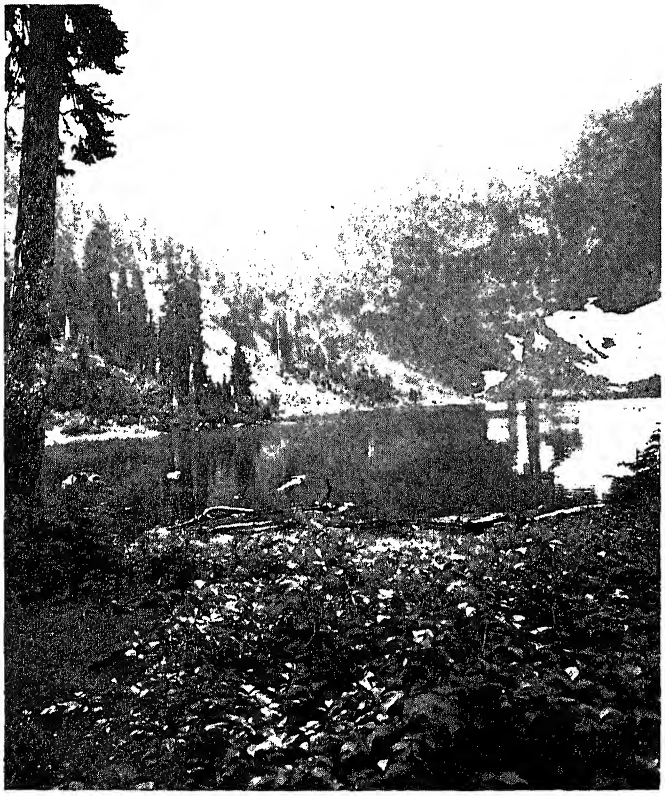


Figure LA-1.– **Lake Twentytwo Research Natural Area, Snohomish County, Washington.**

Figure LA-2.—Natural features of the Lake Twentytwo Research Natural Area. Upper left: Typical specimens of old-growth western redcedar about 2.5-m. d.b.h. growing at lower elevations. Upper right: Lake Twentytwo Creek which is included almost entirely within the natural area. Lower left: Small stand of bigleaf maple (background) which averages 20- to 25-cm. d.b.h. and vine maple community (foreground) which dominates extensive areas of brushfields growing on talus. Lower right: A portion of Lake Twentytwo and the surrounding basin; note the persistent snowbanks in this later summer photograph.



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Pacific Northwest Forest and Range Experiment Station,
Portland, Oregon.

LONG CREEK RESEARCH NATURAL AREA[1]

Western hemlock, western hemlock - western redcedar, and climax red alder stands on a south-exposed mountain slope in the northern Cascades of Washington.

Long Creek Research Natural Area was established on January 2, 1947, as an example of virgin western hemlock (*Tsuga heterophylla*) - western redcedar (*Thuja plicata*) forest type. It complements Lake Twentytwo Research Natural Area, which is located on a north-facing mountainside 4 km. (2.5 miles) to the west. The 259-ha. (640-acre) tract is located in Snohomish County, Washington, and is administered by the Monte Cristo Ranger District (Granite Falls, Washington), Mount Baker National Forest. The natural area occupies the W1/2 of section 17 and E1/2 NE1/4, E1/2 SW1/4, and SE1/4 of section 18, T. 30 N., R. 9 E., Willamette meridian (fig. LC-1). It lies at 48°05′ N. latitude and 121°41′ W. longitude.

ACCESS AND ACCOMMODATIONS

Access is via U.S. Highway 2 and State Highways 9 and 92 from Everett to Granite Falls and Forest Highway 7 to Verlot Ranger Station. Beyond the ranger station follow Forest Highway 7 east for 11.6 km. (7.2 miles) to Red Bridge Campground and turn left on Forest Road 3033. Beginning about 3.2 km. (2 miles) west of the junction, Road 3033 skirts the southern (lower) and, eventually, the western boundaries of the research natural area. In the near future a road providing access to the eastern boundary will be built. There are no trails or roads within the natural area boundary.

The nearest commercial overnight accommodations are in Everett about 56 km. (35 miles) away, although food can be obtained at Verlot and Granite Falls. There are seven public campgrounds within 3 to 14 km. (2 to 9 miles) of the natural area.

ENVIRONMENT

The Long Creek Research Natural Area occupies a portion of the south slope of Wiley Ridge. Elevations range from 1,100 m. (3,600 ft.) above sea level near the top of the ridge to about 380 m. (1,250 ft.) at the foot of the ridge near the South Fork of the Stillaguamish River. Topography is steep to very steep and broken on the slopes to gentle and rolling in the southern third of the area where the toe-slope of the ridge merges with the river terrace. One permanent stream, as well as approximately two-thirds of the Long Creek drainage, is almost entirely within the natural area.

The natural area is located on sedimentary bedrock of Pre-Middle Jurassic age (Hunting et al. 1961). However, this bedrock is covered by stratified glacial outwash of Pleistocene age on lower portions of the natural area. This outwash is of two types — a lower deposit of compact brown sands and gravels of glacial fluvial origin overlain by a deep deposit of blue-gray hard varved silt of glaciolacustrine origin.[2] The varved material con-

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

[2] Information from "Report on Slide on South-Fork Stillaguamish River at Gold Basin Forest Camp." Sept. 30, 1954, 10 p. Typewritten report by Shannon and Wilson, Consulting Engineers, Seattle, to State of Washington Department of Fisheries. (Copy on file Verlot Ranger Station, Granite Falls, Washington.)

sists of thin layers of silt, sand, and clay, horizontally bedded. Many of the beds are extremely unstable, especially when wet, resulting in slides and mudflows. The extensive mass land movements which characterize lower elevations in much of the natural area appear confined to this material.

A wet, cool, maritime climate characterizes the natural area. Annual precipitation is heavy and highly seasonal, although rain is not uncommon during the summer months, and summers are cool. Climatic data from the nearest weather bureau station (Darrington, Washington) about 19 km. (12 miles) northeast are as follows (U.S. Weather Bureau 1956, 1965). They probably approximate climatic conditions encountered at lower elevations in Long Creek Research Natural Area.

Mean annual temperature	9.6°C. (49.4°F.)
Mean January temperature	1.1°C. (33.9°F.)
Mean July temperature	17.4°C. (63.3°F.)
Mean January minimum temperature	-3.2°C. (26.1°F.)
Mean July maximum temperature	25.9°C. (78.7°F.)
Average annual precipitation	2,045 mm. (80.51 in.)
June through August precipitation	154 mm. (6.06 in.)
Average annual snowfall	120 cm. (47.4 in.)

Soils on the natural area have recently been mapped by U.S. Forest Service personnel as part of a soil survey of the Mount Baker National Forest (Snyder and Wade 1970). Soils on gently sloping terrain in the southern portion of the area are markedly unstable and are formed in deep glaciolacustrine deposits. These soils, classed as fine, mixed Andic Haplumbrepts, possess a brown silt loam to silty clay loam surface layer which grades into a slowly permeable silty clay subsoil at approximately 30 cm. (12 in.). On more steeply sloping terrain at intermediate elevations, mapped soils are coarse textured gravelly sandy loams over very deep deposits of very gravelly and cobbly sands. These are derived from marginal lake deposits and are classified as sandy, mixed Typic Ustifluvent. In the northern section of the area, near Wiley Ridge, soils are derived from metasedimentary rocks and are classed as coarse loamy, mixed Typic Ferrods. These soils have a dark reddish brown loam surface and are underlain at about 55 cm. (22 in.) by dark yellowish brown very gravelly loam.

BIOTA

Estimated areas by SAF forest types (Society of American Foresters 1954), as determined from the most recent type map available, are:

No.	*Name*	*Area*
224	Western Hemlock	162 ha. (400 acres)
227	Western Redcedar - Western Hemlock	40 ha. (100 acres)
230	Douglas-Fir - Western Hemlock	40 ha. (100 acres)
221	Red Alder	16 ha. (40 acres)

Vegetation types present, according to Küchler's (1964) classification, would include: Type 2, Cedar - Hemlock - Douglas - Fir Forest; Type 3, Silver Fir - Douglas Fir Forest; and Type 25, Alder-Ash Forest. The natural area is mainly within the *Tsuga heterophylla* Zone (Franklin and Dyrness 1969).

Stands dominated by western hemlock cover the bulk of the natural area (fig. LC-2), but the age, structure, understory composition, number, and species of associated conifers vary greatly from site to site. On the slopes are stands of western hemlock mixed with varying proportions of western redcedar and scattered Douglas-fir (*Pseudotsuga menziesii*) and Pacific silver fir (*Abies amabilis*). Western hemlock is the major climax species, and many small openings are choked with dense hemlock reproduction (fig. LC-2). Hemlocks in one of the stands examined were about 175 years in age, 60-cm. (24-in.) d.b.h. (maximum 81-cm. or 32-in.), and 38 m. (125 ft.) in height. The understory can be typified by *Vaccinium alaskaense*, *Blechnum spicant*, and *Hylocomium splendens*. Other species commonly present include *Vaccinium ovalifolium*, *V. parvifolium*, *Cornus canadensis*, *Clintonia uniflora*, *Polystichum munitum*, and *Rubus pedatus*.

On some benches and the upper slopes of the natural area, mixed stands of Pacific silver fir and western hemlock are encountered in which the silver fir appears to be the major climax species. The understory is dominated

by *Rhytidiopsis robusta*, *Vaccinium alaskaense*, *Rubus pedatus*, *Cornus canadensis*, *Clintonia uniflora*, and *Blechnum spicant*. In one of these stands the 90- to 120-cm. (3- to 4-ft.) diameter and 61-m. (200-ft.) tall hemlocks and silver firs were estimated (from borings) to be over 400 years old.

Within the natural area are large old-growth Douglas-fir 180- to 200-cm. (70- to 80-in.) d.b.h. (fig. LC-2). They are concentrated in the northeast corner of the tract and on drier sites, e.g., around the steep slopes and cliffs in section 18. In the latter location the Douglas-fir is associated with an understory distinguished by the occurrence of *Berberis nervosa*, *Gaultheria shallon*, *Acer circinatum*, *Eurhynchium oreganum*, *Linnaea borealis*, and Pacific yew (*Taxus brevifolia*). Western hemlock is the major climax species.

Around streams, seeps, and similar moist habitats, a community dominated by large western redcedar and a dense understory of *Oplopanax horridum*, *Athyrium filix-femina*, *Blechnum spicant*, and many other herbs may be encountered. Very large redcedars are sometimes encountered on these sites.

A series of interesting red alder (*Alnus rubra*)-dominated communities are found on the unstable glacial deposits in the southern half of the natural area. The area appears to be a mosaic of stands of varying age and size depending upon when the last slump or landslide took place. Associated with the alder is black cottonwood (*Populus trichocarpa*), bigleaf maple (*Acer macrophyllum*), and Sitka spruce (*Picea sitchensis*). The understory includes species of *Petasites*, *Equisetum*, *Stachys*, *Galium*, and *Carex*, *Rubus spectabilis*, *R. ursinus*, *Oplopanax horridum*, and *Polystichum munitum*; and the rank growth obscures innumerable holes and erosion channels in the substrate. Older stands of red alder, Sitka spruce, bigleaf maple, and western redcedar are developing on small areas where the land surfaces have been stable for 30 to 50 years (fig. LC-2). Near the southern edge of the natural area a stand of stunted red alder, willow (*Salix* sp.), and dense *Scirpus* sp. has developed on alluvial deposits of the eroded glacial silts.

Red alder appears to be the likely climax species throughout most of this area. Constant disturbance of the land surface due to mass soil movements and erosion perpetuates the alder and prevents the stands from developing beyond this successional stage.

Mammals believed to utilize the natural area are listed in table LC-1.

Except for the stream sides and unstable land surfaces associated with the glacial deposits, no specialized habitats are known within the natural area.

HISTORY OF DISTURBANCE

There is no evidence of recent fires or human disturbance within the Long Creek Research Natural Area, although a small structure is shown in the SW1/4 of section 17 on the U.S. Geological Survey map of the Silverton Quadrangle. A small farm once existed adjacent to the southern boundary and National Forest lands adjacent to the west, south, and east boundaries are in process of being logged.

RESEARCH

No research is presently being conducted on the natural area. The mosaic of communities and environments on the unstable till deposits appears to offer unique research opportunities, perhaps even of geomorphologic phenomena.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Silverton, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1957; and *geology* — *Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). Either the District Ranger (Monte Cristo Ranger District) or Forest Supervisor (Mount Baker National Forest, Bellingham, Washington) can provide details on the most recent aerial photo coverage and forest type maps for the area.

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Table LC-1. — Tentative list of mammals for Long Creek Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex cinereus	masked shrew
	Sorex obscurus	dusky shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis keeni	Keen myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer

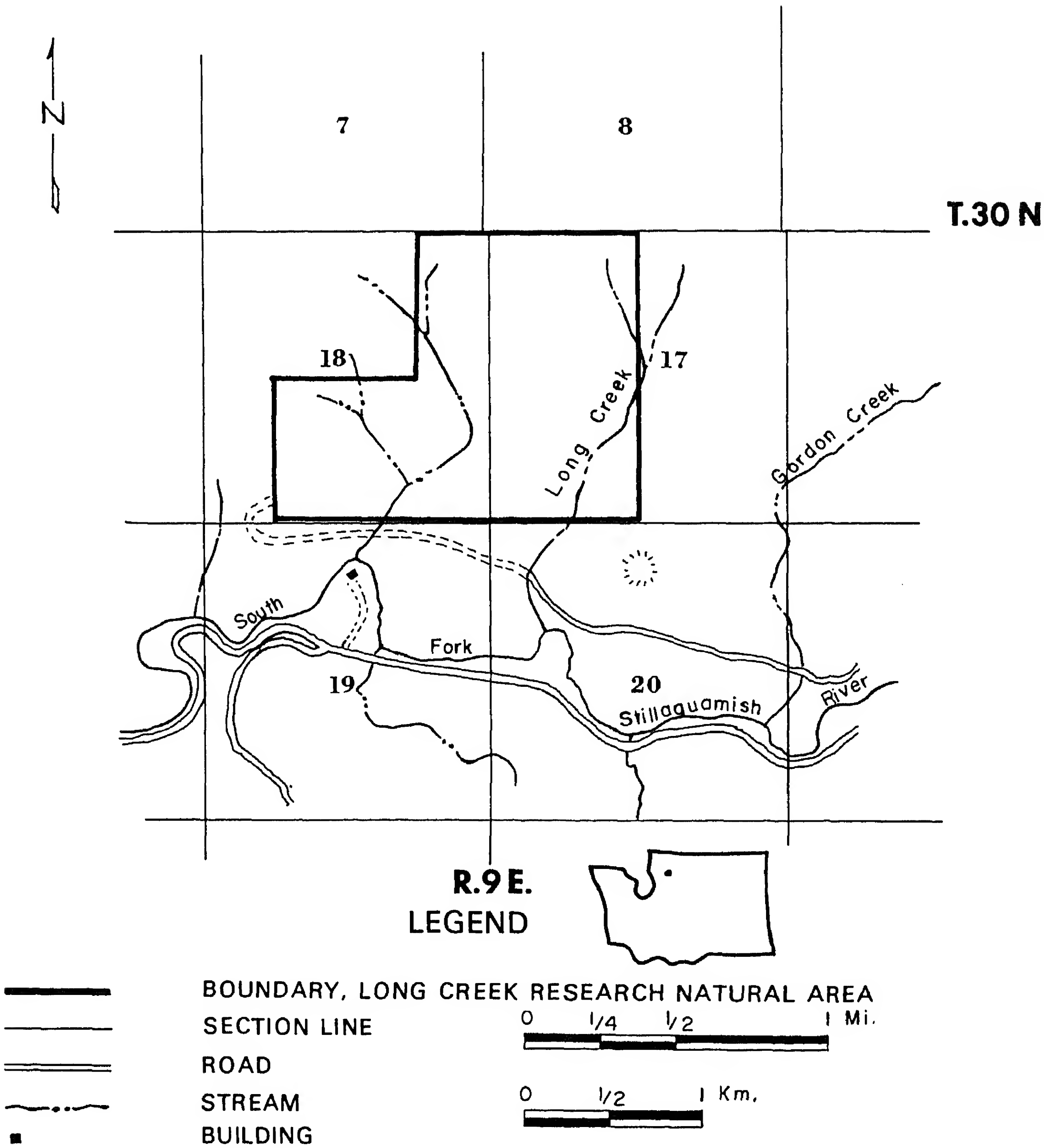
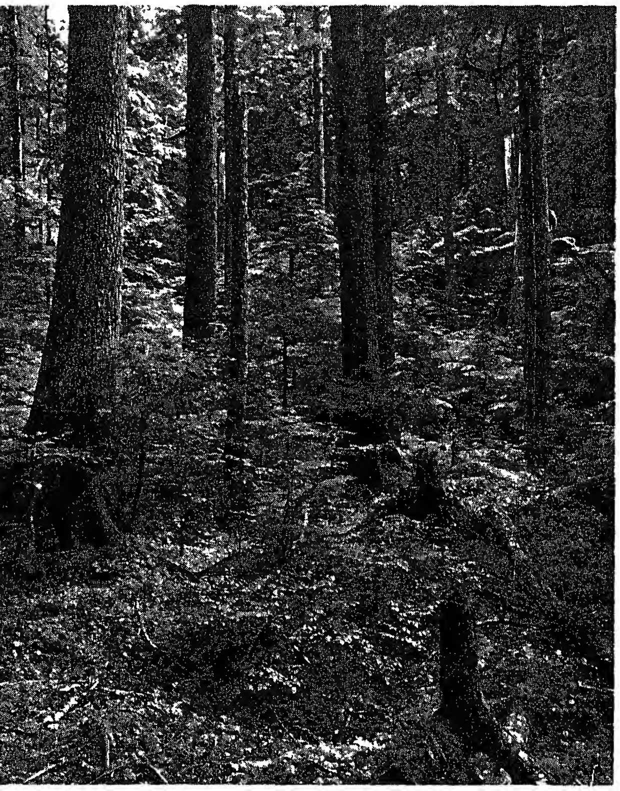
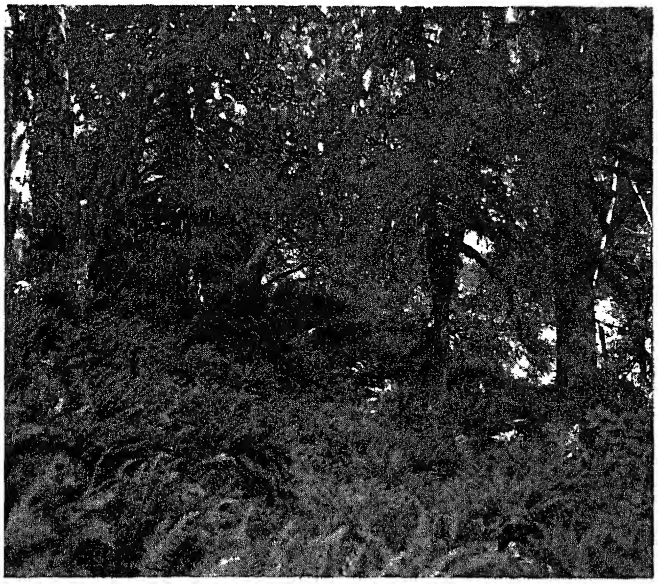
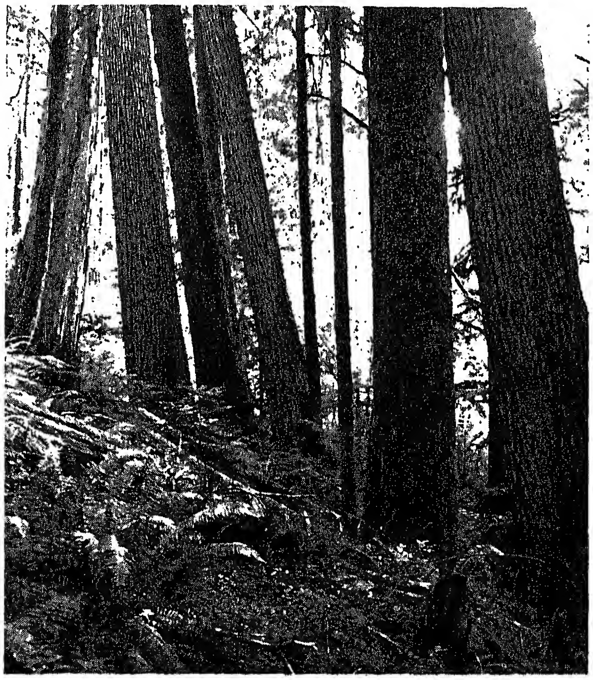


Figure LC-1.— Long Creek Research Natural Area, Snohomish County, Washington.

Figure LC-2.—Communities of the Long Creek Research Natural Area. Upper left: Typical stand of western hemlock averaging 45- to 70-cm. d.b.h. Upper right: Stand of red alder, Sitka spruce, bigleaf maple, and *Polystichum munitum* developed on portion of unstable glacio-lacustrine sediments at lower elevations. Lower left: Small opening in mature forest of western hemlock occupied by dense reproduction of western hemlock and small amounts of Pacific silver fir and western redcedar. Lower right: Group of large, old-growth Douglas-firs averaging 175- to 200-cm. d.b.h.



MAPLE KNOLL RESEARCH NATURAL AREA[1]

Bigleaf maple and Oregon white oak stands on opposite slopes of a foothill ridge in Oregon's Willamette Valley.

Maple Knoll Research Natural Area was stablished on December 27, 1966. It provides xamples of bigleaf maple (*Acer macrohyllum*) and Oregon white oak (*Quercus arryana*) stands typical of hilly areas in and djacent to the Willamette Valley in western regon. The 4.5-ha. (100-acre) natural area located in Benton County, Oregon, and is dministered by the William L. Finley Naonal Wildlife Refuge (Route 2, Box 208, orvallis, Oregon), Bureau of Sport Fisheries nd Wildlife. It is located in sections 31 and 2, T. 13 S., R. 5 W., Willamette meridian, : 44°24′ N. latitude and 123°20′ W. longitude.

CCESS AND CCOMMODATIONS

The Maple Knoll Research Natural Area located a short distance off U.S. Highway 9W, about 16 km. (10 miles) south of Corallis. An all-weather graveled road aproaches within about 0.8 km. (0.5 mile) the tract. It is bounded by a fire road along s northeastern edge, but this road cannot e driven during winter months. A mainined trail traverses the natural area from est to east (fig. MA-1). Visitors should conct the Refuge Manager about the best route of approach. Commercial accommoda are available in Corvallis; there are no p campgrounds available within the refuge

[1] Description prepared by Dr. J. F. Franklin, U.S. epartment of Agriculture, Forest Service, Pacific orthwest Forest and Range Experiment Station, orestry Sciences Laboratory, Corvallis, Oregon.

ENVIRONMENT

The Maple Knoll Research Natural occupies both slopes (north and south) the top of a low, east-west oriented v foothill ridge (fig. MA-2). Slopes are gene moderate. Elevations range from about 168 m. (300 to 500 ft.). There are no str or springs within the natural area. A swa area is located on low ground adjacent t northern boundary.

The ridge occupied by the natural ar composed of light gray to yellowish br arkosic micaceous sandstone with thin stone partings (Vokes et al. 1954). material belongs to the Spencer formati upper Eocene age. A narrow dike or sill body of intrusive igneous rocks runs east to west along the ridge line; this in sion may be composed of basalt, gabbr diabase.

The natural area is located in wes Oregon, an area of mild, moist climate. ever, it is within the Willamette Valley, w is located between the Coast and Cas Ranges and is, therefore, subject to the s what warmer and drier climate typica interior western Oregon valleys. The sum dry period is especially pronounced. Re sentative climatic data from the Corv weather station are as follows (U.S. Wea Bureau 1965):

Mean annual temperature	11.6°C. (53
Mean January temperature	4.1°C. (39
Mean July temperature	19.2°C. (66
Mean January minimum temperature	0.6°C. (33
Mean July maximum temperature	27.1°C. (80
Average annual precipitation	957 mm. (37.
June through August precipitation	49 mm. (1

loam occupies the ridge top and south s. The Dixonville series has been classi- as a Brunizem and Pachic Ultic Argix- according to the old and new soil classi- ons, respectively. It consists of a well- ed silty clay loam surface soil over clay s formed in colluvium from basic igneous A typical horizon sequence is as follows: dark brown A1 from 0 to 13 cm.; very gray brown A3 from 13 to 32 cm.; and dark brown, clayey B2t from 32 to 66 cm. Bellpine series (ex-Bellfountain soil ser- has been classified as a Red-Yellow Pod- and Typic Haploxerult. It consists of a erately deep silty clay loam surface soil clay and is typically formed in colluvium sedimentary rocks. A typical horizon ence is as follows: dark reddish brown rom 0 to 15 cm.; dark reddish brown B1 15 to 25 cm.; and dark red silty clay t from 25 to 50 cm.

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reas by vegetation types are as follows:

Name	*Area*
af maple forest	14 ha. (35 acres)
n white oak forest	18 ha. (45 acres)
land	12 ha. (29 acres)

Oregon white oak stands can be assigned AF forest cover type 233, Oregon White (Society of American Foresters 1954); Society does not recognize a type in which af maple is the dominant species. The forest can also be assigned to Küchler's 4) Type 26, Oregon Oakwoods, and big- maple stands are possibly assignable to Type 25, Alder-Ash Forests. The natural is located within the Interior Valley *us-Quercus-Pseudotsuga*) Zone of Frank- nd Dyrness (1969).

gleaf maple dominates the stands found ne north side of the ridge. These devel- following logging of the area during or of logging. Oregon white oak and Douglas-fir (*Pseudotsuga menziesii*) are also encountered. The trend of forest succession is not entirely clear; grand fir and bigleaf maple are generally both represented in reproductive size classes.

The forest stands on the top and south slopes of the ridge are dominated by Oregon white oak with a scattering of Douglas-fir. According to Anderson (1970), there is a relatively dense canopy cover (80 percent) and trees often exceed 18 m. (60 ft.) in height. Bigleaf maple are occasionally encountered in the south slope stands and, with Douglas-fir, appear to dominate reproductive size classes.

Composition of the understory community varies with aspect and strong changes in the overstory. Bigleaf maple stands on the north slopes typically have well-developed shrub and herbaceous layers. *Philadelphus lewisii*, *Corylus cornuta* var. *californica*, and Pacific yew (*Taxus brevifolia*) are common tall shrub species. *Polystichum munitum* dominates the herbaceous layer with a rich variety of associated herbs and mosses. The understory in the white oak stands is characterized by the low shrub and liana species *Rhus diversiloba*. The abundance of this species is believed a consequence of heavy grazing (Thilenius 1964, 1968). Other understory species encountered include *Rosa eglanteria*, *Symphoricarpos albus*, and *Rubus ursinus* in the shrub layer and *Galium* sp., *Osmorhiza nuda*, *Satureja douglasii*, and several perennial and annual grasses in the herb layer. The oak stands relate to Thilenius (1964, 1968) *Quercus garryana/Rhus diversiloba* community type.

The grasslands were not examined in detail. They have been heavily grazed and contain a high proportion of introduced species which include all of the annual grass dominants. In addition to a variety of herbaceous plants — perennial and annual grasses and forbs

ifauna of the oak stands are known in tail (Anderson 1970). There are 15 species hich inhabit the tract as permanent resints, in addition to seven occasional species, summer resident species, and three winter sident species. These include the hairy woodcker (*Dendrocopos villosus*), downy woodcker (*Dendrocopos pubescens*), black-capped ickadee (*Parus atricapillus*), white-breasted thatch (*Sitta carolinensis*), brown creeper erthia familiaris*), Bewick's wren (*Thryones bewickii*), robin (*Turdus migratorius*), utton vireo (*Vireo huttoni*), Rufous-sided whee (*Pipilo erythrophthalmus*), and Oren junco (*Junco oreganus*).

ISTORY OF DISTURBANCE

Human activities have had a strong inence on the development of existing forest nds within the Maple Knoll Research tural Area. The stands on the north slope the ridge were logged 30 or more years ago. e original stands were probably a mixture Douglas-fir, grand fir, and bigleaf maple. lection of Douglas-fir during the logging erations assisted in the conversion of the nd to bigleaf maple. The Oregon white oak nds on the south slope of the ridge have obably never suffered significant logging. wever, Habeck (1961, 1962) and Thilenius 964, 1968) have provided abundant evidence at most of the closed canopy Oregon white k stands in the Willamette Valley are a nsequence of fire control activities instied with the settlement of the valley in the rly 1800's. Prior to this time, open oak vannas and grasslands were believed to ve been maintained by periodic fires, posly set by Indians.

Sheep heavily grazed the oak woodlands d grasslands on the south slope of the ridge til establishment of the wildlife refuge in 63. No grazing of the area has been allowed ce that time. This grazing has significantly ered the composition of the grassland com-

RESEARCH

The natural area has been used as a site undergraduate research work by ecology wildlife students from Oregon State Univ sity; the Refuge Manager can provide deta The south slope stands of Oregon white were one of five sampling sites used Anderson (1970) in a study of fluctuation composition and abundance of bird specie Oregon white oak stands.

Despite the disturbances by logging grazing, the Maple Knoll Research Natu Area is a very valuable research tract si the communities are typical of many fores areas found in the Willamette Valley, protected sites of these types are extrem rare. Successional studies in the maple, and grassland types seem especially app priate to determine what effect human act ties have had on them and how rapidly t are returning to a more natural state that logging and grazing have been elimina Other opportunities include the study of va tions in community composition, structu and productivity on contrasting but co guous topography and soils and of variati in animal populations and behavior in stron contrasting vegetation types.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural a include the following: *Topography* — Monroe, Oregon quadrangle, scale 1:62,5 issued by the U.S. Geological Survey in 19 *geology* — *Geology of the West Central B der Area of the Willamette Valley, Oreg* scale 1:62,500 (Vokes et al. 1954). Pho graphs taken in June 1970 can be purcha from the Agricultural Stabilization and C servation Service, Benton County ASC Co mittee, P.O. Box 1027, Corvallis, Oreg

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	Scapanus townsendi	Townsend mole
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
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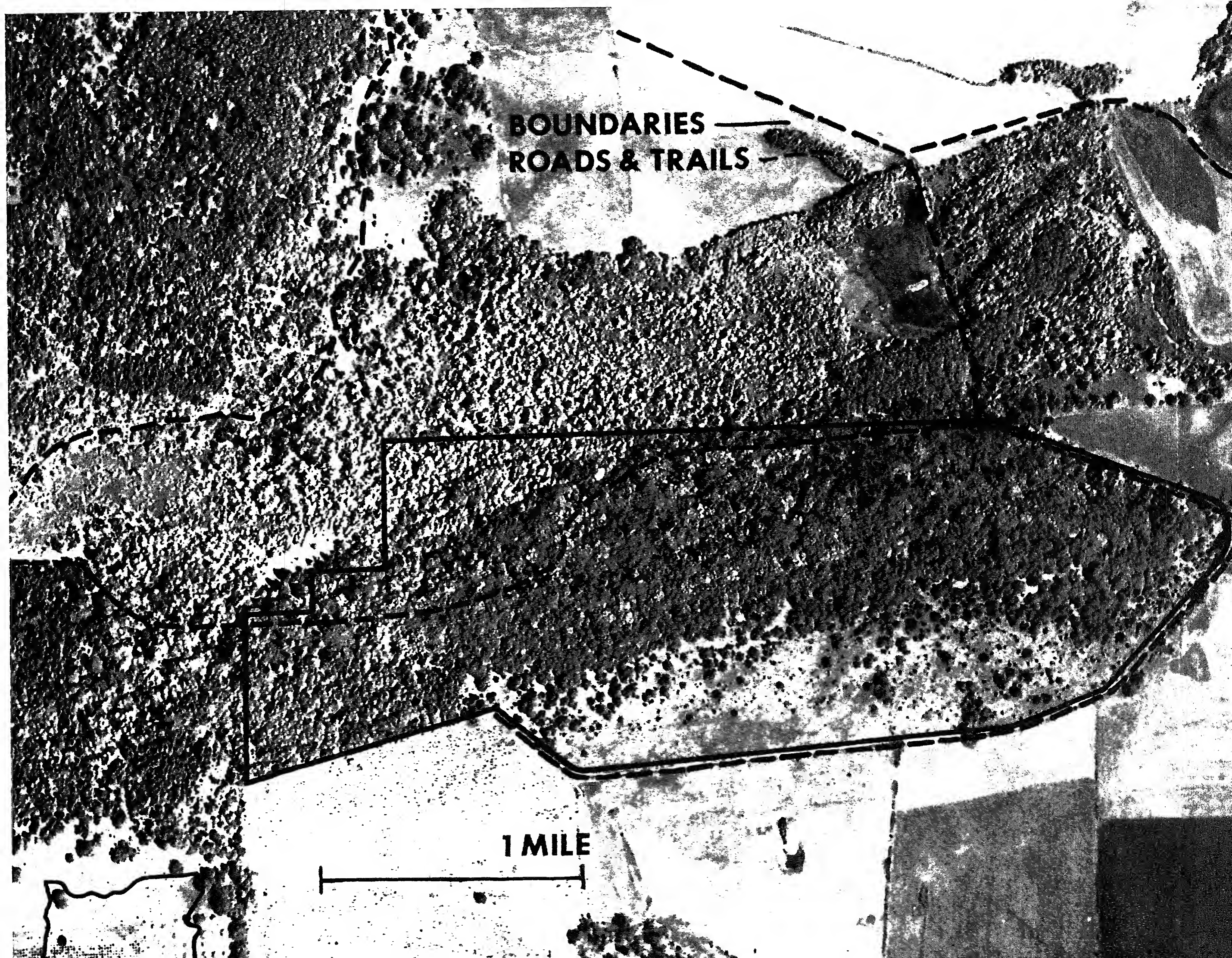
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared
Lagomorpha	*Sylvilagus bachmani*	brush rabbit
	Sylvilagus floridanus	eastern cottontail
Rodentia	*Arborimus longicaudus*	red tree vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squi
	Microtus canicaudus	gray-tailed vole
	Microtus oregoni	Oregon or creeping v
	Microtus townsendi	Townsend vole
	Neotoma fuscipes	dusky-footed wood ra
	Peromyscus maniculatus	deer mouse
	Sciurus griseus	western gray squirre
	Spermophilus beecheyi	California ground sq
	Tamiasciurus douglasi	chickaree
	Thomomys bulbivorus	giant pocket gopher
Carnivora	*Canis latrans*	coyote
	Lynx rufus	bobcat
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel o
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civ
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Odocoileus h. columbianus*	black-tailed deer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ROADS & TRAILS
1 MILE

Figure MA-2.—Natural features of Maple Knoll Research Natural Area. Upper: Typical stand of bigleaf maple on the north slope of the tract. Center: View of the eastern edge of the natural area where the Oregon white oak and bigleaf maple stands found on south (left) and north (right) slopes, respectively, merge. Bottom: General view of the north side of the Maple Knoll Research Natural Area and its environs; Pigeon Butte Research Natural Area is on the left.

MEEKS TABLE RESEARCH NATURAL AREA[1]

Ponderosa pine/pinegrass forest and intermingled stiff sagebrush-grass communities characteristic of the eastern slopes of the Washington Cascade Range.

The Meeks Table Research Natural Area was established in July 1948 to exemplify ponderosa pine/pinegrass (*Pinus ponderosa/ Calamagrostis rubescens*) communities and associated grasslands typical of the Cascade Range in eastern Washington. The 27-ha. (68-acre) tract is located in Yakima County, Washington, and administered by the Naches Ranger District (Naches, Washington), Snoqualmie National Forest. Its elongated oval shape is dictated by topography (fig. ME-1). It is located in sections 5 and 6, T. 15 N., R. 14 E., Willamette meridian, at 46°15′ N. latitude and 121°05′ W. longitude.

ACCESS AND ACCOMMODATIONS

The tract is located about 65 km. (40 miles) northwest of Yakima and is approached via U.S. Highway 410. Directions should be obtained at the Naches Ranger Station for identifying the graveled Forest Service roads to the area and the trailhead location which leads to Meeks Table along a single, steep, narrow ridge. Access during summer is good but becomes very difficult during the w due to snow. Public accommodations are able in Yakima and Naches; primitive camps are found in the vicinity of Table.

ENVIRONMENT

The Meeks Table Research Natura varies in elevation from 1,280 to 1,5 (4,200 to 4,525 ft.). Topographically, Table is an isolated flat-topped butte, nant of a former basalt-capped plateau, 150 m. (500 ft.) above the surrounding terrain. It is surrounded by precipitou with a 60- to 90-m. (200- to 300-ft.) v drop to talus slopes below.

A modified continental climate pr Most precipitation occurs as snow duri cool, cloudy winter. Summers are generally low in precipitation, and l cloudless. One to 3 months of droug common. Climatic data from Bumping located in a valley 16 km. (10 miles are as follows (U.S. Weather Bureau 19

Mean annual temperature	4.7°C. (
Mean January temperature	−4.9°C. (
Mean July temperature	14.5°C. (
Mean January minimum temperature	−10.0°C. (
Mean July maximum temperature	23.6°C. (
Average annual precipitation	1,214 mm. (
July through August precipitation	69 mm.
Average annual snowfall	554 cm. (2

It is undoubtedly much drier and su are warmer on the natural area itself.

Soils in the area have not been mappe some descriptions available in Run (1951) research report follow. Weakl zolized soils occur under forested stands are developed in approximately 20 cm. of volcanic ash over buried materials. A d matted, freshly decomposed mull

[1] Description prepared by Drs. Arthur R. Tiedemann, G. O. Klock, and H. W. Berndt, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forest Hydrology Laboratory, Wenatchee, Washington, and Dr. F. C. Hall, U.S. Department of Agriculture,

	little organic matter; pH 6.4.
5 to 20 cm.	Light brown loamy textured volcanic ash; crumb structure; abundant roots; pH 6.4.
20 to 45 cm.	Gritty clay with strongly developed nut structure and colloidal staining on cleavage surfaces; pH 5.8.
45 to 50 cm. +	Black fragmented clay; entire mass is dense waxy deposit.

ght-gray, ashy sand observed by Rum-
ppears to be lenses of volcanic ash
ng from the eruption of Mount Maza-
Mount St. Helens. In the IIBb hori-
emnants of glacial till have been ob-
Shallower, nonpodzolized soils (Rego-
Entisols) occur in areas of sagebrush
rass which commonly have a biscuit-
nicrotopography. These soils are stonier
hey lack the wind-deposited ash layers
on forested sites. The horizon sequence
eper, biscuit-type area is:

0 to 15 cm.	Light brown loam; friable crumb structure; 20 to 40 percent stone.
15 to 40 cm.	Brown gritty clay; cleavage planes show colloidal staining; 30 to 50 percent stone; pH 6.5.
40 cm. +	Moderately cracked bedrock of biabase material; slight lime depositions on rock surfaces.

is little or no litter or organic layer
t. Very shallow soils 5 to 10 cm. (2 to
deep occur along the windward side
west rim) of the butte and are occupied
y sparse vegetation.

TA

imated areas by plant community are:

Pinus ponderosa/Calamagrostis rubescens-Lupinus laxiflorus .... 7 ha. (17 acres

Pseudotsuga menziesii/Calamagrostis rubescens-Arnica cordifolia .... 6 ha. (15 acres

The areas of *Pinus/Calamagrostis-Lupinu*
can be assigned to SAF cover type 237, In
terior Ponderosa Pine (Society of America
Foresters 1954), and Küchler's (1964) Typ
11, Western Ponderosa Pine Forest. The area
of *Pseudotsuga/Calamagrostis-Arnica* can b
assigned SAF forest cover type 214, Ponderos
Pine-Western Larch-Douglas-Fir, and prob
ably to Küchler's Type 12, Douglas Fir Fores
The grass-stiff sagebrush (*Artemisia rigida*
communities probably fall within Küchler'
Type 55, Sagebrush Steppe. The entire trac
appears to fall within the *Abies grandis* Zon
found on the eastern slope of Washington'
Cascade Range (Franklin and Dyrness 1969)

The *Poa sandbergii-Eriogonum douglas*
Artemisia rigida community is found on th
north and south extremes of Meeks Tabl
(figs. ME-2 and ME-3). These are harsh, rock
outcrops with little soil development an
sparse vegetative cover (22 percent). Lo
forbs and halfshrubs such as *Sedum stenope*
tallum, *Arenaria congesta*, and *Eriogonu*
douglasi account for more than half of th
vegetal cover (table ME-1). Sandberg blu
grass (*Poa sandbergii*) and bottlebrush squi
reltail (*Sitanion hystrix*) are the most abu
dant perennial grasses. Cheatgrass (*Bromu*
tectorum) is common in this communit
Bitterbrush (*Purshia tridentata*) and sti
sage comprise most of the shrub cover. So
depth varies from 5 cm. (2 in.) to 6 dm. (2 ft.
Soils are lower in cation exchange capacit
organic matter, and total nitrogen than th
other communities on the Table (table ME-2
This community is similar to those found o
the *Artemisia rigida-Poa sandbergii* habit
type described by Daubenmire (1970). Tra
sitions with the forested communities and th

rigida is the most extensive community type on Meeks Table, occurring in large openings between the forested areas (figs. ME-2 and ME-3). Total vegetal cover is 41 percent. Columbia needlegrass (*Stipa columbiana*), pinegrass (*Calamagrostis rubescens*), and Sandberg bluegrass are the predominant grasses (table ME-1). Numerous forbs and halfshrubs account for more than half of the cover in this community. *Sedum* is the most common forb and *Phlox diffusa* the most common halfshrub. Small annual forbs such as *Collinsia parviflora* and *Polygonum kelloggii* occur frequently. Stiff sage is the most common shrub but accounts for only 10 percent of the total cover. This community resembles sagebrush-grass communities which have been depleted by livestock overuse; however, livestock have never grazed Meeks Table. Within this community, there are areas resembling biscuit-swale topography with islands of pinegrass and bluebunch wheatgrass (*Agropyron spicatum*). Soil depth ranges from 6 dm. (2 ft.) to 2.7 m. (9 ft.). Soil bulk density and pH are the highest of any of the communities (table ME-2). Contents of organic matter and total nitrogen are intermediate. Transition to the forest communities is marked by an abrupt rise in the topography of 15 to 30 cm. (6 to 12 in.) similar to the rise in the islands in the biscuit-swale topography.

The *Pinus ponderosa/Calamagrostis rubescens/Lupinus laxiflorus* community has a stocking rate of 91 trees per ha. (37 trees per acre). Of these, 80 are ponderosa pine and 11 are Douglas-fir (*Pseudotsuga menziesii*). Ponderosa pines average 64-cm. (25-in.) d.b.h. and vary from sapling size to 163 cm. (64 in.). The scattered Douglas-fir trees have an average d.b.h. of 46 cm. (18 in.) and range in size from saplings to 84 cm. (34 in.). Reproduction of both tree species is sparse. Crown cover of the overstory averages 26 percent but is as great as 70 percent in places. Cover of understory vegetation is 76 percent and clearly

the highest level of total nitrogen of the communities (table ME-2).

The *Pseudotsuga menziesii/Calamag rubescens-Arnica cordifolia* community from the *Pinus/Calamagrostis-Lupinu* munity in composition and cover of both story and understory and in stocking Average number of trees per ha. is 39 per acre) of which 234 (95 per acr Douglas-fir, 90 (36 per acre) are pon pine, and the remainder are western (*Larix occidentalis*) and grand fir *grandis*). Douglas-fir trees range in siz saplings to 117 cm. (46 in.), averaging (14 in.). Ponderosa pine, western larc grand fir average 43-cm. (17-in.), 36-cr in.), and 13-cm. (5-in.) d.b.h., respec Reproduction of Douglas-fir and grand good. Crown cover of trees ranges from 100 percent and averages 51 percen such a high percentage of tree cover, percent crown cover of understory vege is surprisingly high. Three-fourths cover is pinegrass and elk sedge (table *Arnica cordifolia* is the predominan Soil depth varies from 2 to 4.5 m. (7 to Properties are similar to the soil of the *Calamagrostis-Lupinus* community that bulk density and total nitrogen are (table ME-2).

Both of the forested communities are ably occupying habitats analogous *Pseudotsuga menziesii-Calamagrostis scens* habitat type of Daubenmire and enmire (1968).

Mammals believed to utilize the area as residents or transients are li table ME-3.

HISTORY OF DISTURBANCE

Fire scars on ponderosa pine (fig. indicate ground fires periodically the area prior to initiation of fire programs in 1910. Lack of dominar

estic livestock have never grazed the ecause the very narrow, precipitous t the butte's west end is inimical to ck passage. No other disturbance is

ARCH

mell (1951) evaluated the ungrazed tion and soils on Meeks Table and red them with those on Devil's Table, 16 km. (10 miles) distant, an area had been overgrazed by livestock. ed studies of the vegetation and soils progress and some of the results are orated into this description; a complete will be published in the future.[2]

Meeks Table Research Natural Area es interesting research opportunities: forest succession without a past history stock use; (2) on vegetation-soil relation- in relation to the intricate pattern of ed and nonforested plant communities;) as a benchmark area for evaluating nt stands which have been grazed and .

S AND AERIAL TOGRAPHS

special topographic or geologic maps vailable for the natural area which are ently detailed to be useful. Either the ct Ranger (Naches Ranger District) or t Supervisor (Snoqualmie National For-

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search by Drs. A. R. Tiedemann, G. O. Klock, W. Berndt, U.S. Forest Service, Forest Hy- Laboratory, Wenatchee, Washington.

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Plant life form and species	*Eriogonum-Artemisia*		*Phlox-Artemisia*		*Calamagrostis-Lupinus*		*Calamagro- Arnic*
	Frequency	Cover	Frequency	Cover	Frequency	Cover	Frequency
Grasses and sedges:							
Poa sandbergii	78	1.6	63	1.6			
Danthonia unispicata	22	.3	24	.8			
Sitanion hystrix	36	.9	29	.3			
Bromus tectorum	44	.9					
Stipa columbiana			90	8.8			10
Calamagrostis rubescens			12	2.4	100	42.7	77
Carex geyeri					90	11.2	97
Other grasses and sedges		.8		1.4		1.4	
Total grasses and sedges		4.5		15.3		55.3	
Forbs and halfshrubs:							
Eriogonum douglasi	54	1.9					
Antennaria dimorpha	60	1.4					
Arenaria congesta	76	1.0					
Sedum stenopetallum	92	1.4	68	1.1			
Allium acuminatum	26	[1]					
Lewisia rediviva	22	[1]					
Phlox diffusa			51	4.3			
Madia glomerata			41	.6			
Lomatium triternatum			41	.5			
Lomatium dissectum			41	.6			
Lomatium nudicaule			42	.8			
Collinsia parviflora			40	.1			
Polygonum kelloggii			49	.3			
Achillea millefolium					63	3.3	
Anaphilis margaritacea					50	.8	
Lupinus laxiflorus					96	8.3	47
Erythronium grandiflorum					47	.7	27
Arnica cordifolia					70	3.0	90
Hieracium cynoglossoides					40	.7	
Frasera speciosa							13
Osmorhiza chilensis							13
Other forbs and halfshrubs		6.3		13.9		3.7	
Total forbs and halfshrubs		12.0		21.6		20.5	
Shrubs:							
Artemisia rigida	26	1.4	49	3.7			
Purshia tridentata	12	2.9					
Arctostaphylos uva-ursi	2	.8					3
Potentilla fruticosa			13	.2			
Holodiscus discolor					3	.2	
Ribes spp.							7
Total shrubs		5.1		3.9		.2	
Total, all plants		21.6		40.8		76.0	

[1]Trace.

nmunity	density	Moisture	percentage	capacity	pH	matter		
	g/cm.³	.06 atm.	15 atm.	me./100 g.		. . . . Percent		
sia	1.30	28	15	26	6.3	3.2	0.14	0.018
grostis-	1.07	32	18	25	5.9	4.6	.18	
suga/ grostis-	.96	36	23	24	5.9	4.0	.12	.011
um- sia	1.08	33	21	16	6.2	2.2	.09	

	Scapanus orarius	coast mole
	Sorex cinereus	masked shrew
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared b
Lagomorpha	*Lepus americanus*	snowshoe hare
	Lepus californicus	black-tailed jack rabb
	Lepus townsendi	white-tailed jack rabb
	Ochotona princeps	pika
	Sylvilagus nuttalli	mountain cottontail
Rodentia	*Clethrionomys gapperi*	Gapper red-backed vo
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirr
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus oregoni	Oregon or creeping vo
	Neotoma cinerea	bushy-tailed wood rat
	Perognathus parvus	Great Basin pocket m
	Peromyscus maniculatus	deer mouse
	Sciurus griseus	western gray squirrel
	Spermophilus saturatus	Cascades mantled gro
	Spermophilus townsendi	Townsend ground squ
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket goph
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or coug
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or
	Mustela frenata	long-tailed weasel
	Taxidea taxus	badger
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

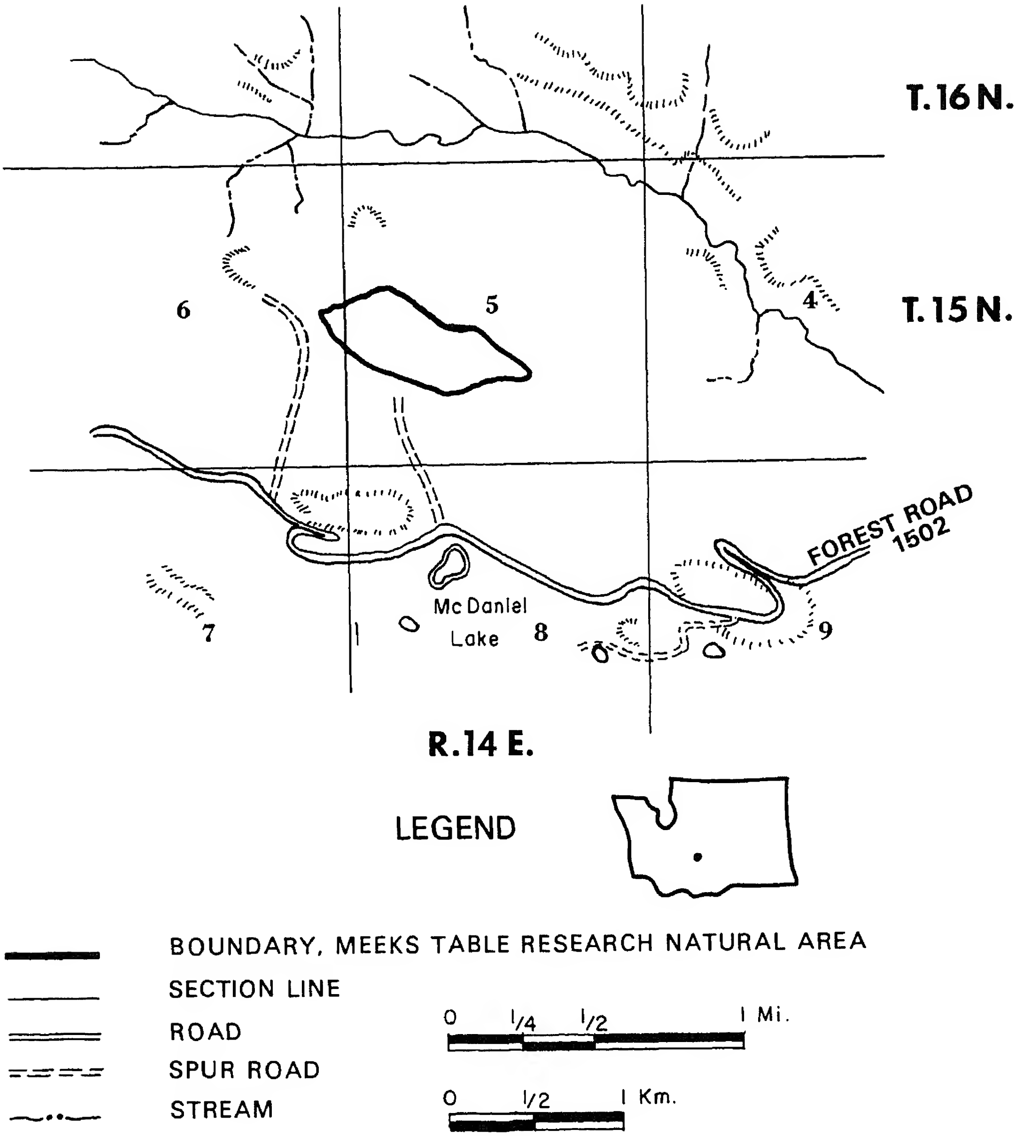

Figure ME-1.– Meeks Table Research Natural Area, Yakima County, Washington.

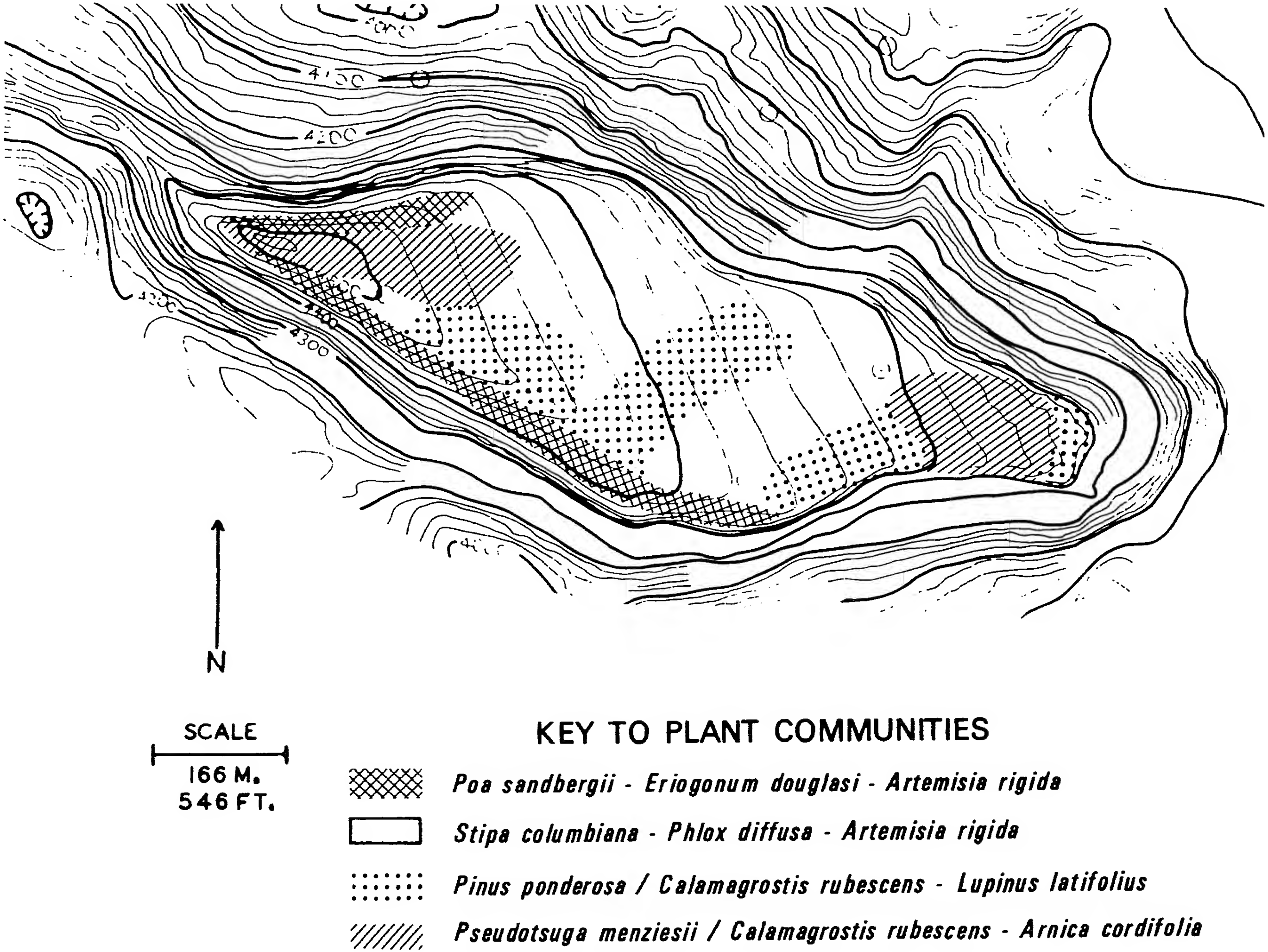

Figure ME-2.– Distribution of plant communities on Meeks Table Research Natural Area; contour interval is approximately 6 m. (20 ft.).

Figure ME-3.—Communities of Meeks Table Research Natural Area. Upper left: *Pinus/Calamagrostis-Lupinus* community; tree reproduction is scant and fire scars common (note tree left of meter board). Upper right: *Pseudotsuga/Calamagrostis-Arnica* community; Douglas-fir and grand fir dominate the reproduction. Lower left: *Poa-Eriogonum-Artemisia* community. Lower right: *Stipa-Phlox-Artemisia* community.




METOLIUS RESEARCH NATURAL AREA[1]

Ponderosa pine forests on flat topography and steep westerly slopes typical of the east slope of the Cascade Range in central Oregon.

Metolius Research Natural Area was established June 1931. It exemplifies ponderosa pine/bitterbrush (*Pinus ponderosa/Purshia tridentata*) (on flats) and ponderosa pine - Douglas-fir/green manzanita (*Pinus ponderosa - Pseudotsuga menziesii/Arctostaphylos patula*) (on steep westerly slopes) communities. These occupy extensive areas on the east slopes of the Cascade Range in central Oregon. The 581-ha. (1,140-acre) tract is located in Jefferson County, Oregon, and is administered by the Sisters Ranger District (Sisters, Oregon), Deschutes National Forest. The rectangular area encompasses parts of sections 25, 26, 35, and 36, T. 12 S., R. 9 E., Willamette meridian (fig. MI-1); boundaries are based on legal lines. It is located at 49° N. latitude and 121°40′ W. longitude.

ACCESS AND ACCOMMODATIONS

Access is via U.S. Highway 20 and a forest road leading into the Metolius River drainage. The natural area is located about 29 km. (18 miles) northwest of Sisters and is most easily approached via U.S. Highway 20 and 16 km. of paved forest roads. Access is good during summer, but snow creates difficulties during the winter. Public accommodations are available at Camp Sherman, about 2 km. (1 mile) south of the tract, and at Sisters, Oregon; there are numerous improved forest campgrounds in the general area.

ENVIRONMENT

The Metolius Research Natural Area occupies two contrasting landforms; the western half is located on a nearly flat bench along the Metolius River and the eastern half occupies the very steep, west slope of Green Ridge. Elevations range from about 850 to 1,460 m. (2,800 to 4,800 ft.).

The geology of the natural area is strongly correlated with the topography. Bedrock in the western half is basalt and basaltic andesite lavas (Williams 1957). These Pleistocene-Recent materials belong to the High Cascade formation. The natural area actually straddles the Metolius fault and steep slopes in the eastern half of the tract are actually a fault escarpment. These slopes and Green Ridge itself are composed of Pliocene and Pleistocene olivine basalts and basaltic andesites of the High Cascades (Williams 1957). The surface of the entire natural area has 2 to 5 cm. (1 to 2 in.) of dacite pumice from ancient Mount Mazama and up to 7 cm. (3 in.) of basaltic ash from cinder cones to the east (Taylor 1968).

A modified continental climate prevails. Most precipitation occurs as snow during the cool, cloudy winter. Summers are warm, generally low in precipitation and largely cloudless. One to 3 months of drought are common. Climatic data from Sisters, 22 km. (14 miles) southeast near the forest-steppe boundary, are as follows (West 1964):

Mean annual temperature	7.9° C. (45.5° F.)
Mean January temperature	−0.5° C. (31.0° F.)
Mean July temperature	17.4° C. (63.4° F.)
Mean annual precipitation	408 mm. (16.07 in.)
June through August precipitation	36 mm. (1.40 in.)

[1] Description prepared by Dr. F. C. Hall, U.S. Department of Agriculture, Forest Service, Region 6, Portland, Oregon.

Soils on the natural area have not been mapped or described. Throughout the tract, they are primarily dacite pumice and other aeolian volcanic ejecta of sandy loam to loamy sand texture over buried profiles. Minimal profile development is evident and would probably be classed as Regosol. A soil profile described on similar habitat a short distance away appeared as follows (West 1964):

O	5 to 0 cm.	Mull type humus from conifer and shrub litter.
A1	0 to 10 cm.	Dark brown (7.5 YR 4/4, dry) pumicy loamy sand; pH 7.3.
AC1	10 to 50 cm.	Strong brown (7.5 YR 5/6, dry) pumicy sand; pH 8.0.
AC2	50 to 152 cm.+	Brownish yellow (10 YR 6/6, dry) pumicy sand; pH 7.7; increasing size and density of gravel with depth.

BIOTA

Estimated area by plant community:

Name	*Area*
Pinus ponderosa/Purshia tridentata/Stipa occidentalis	260 ha. (640 acres)
Pinus ponderosa/Arctostaphylos patula	270 ha. (675 acres)
Pseudotsuga menziesii-Larix occidentalis-Pinus ponderosa/Arctostaphylos patula	51 ha. (125 acres)

The ponderosa pine communities can be assigned to SAF forest cover type 237, Interior Ponderosa Pine (Society of American Foresters 1954), and to Küchler's (1964) Type 10, Ponderosa Pine Shrub Forest. The Douglas-fir-western larch (*Larix occidentalis*)-ponderosa pine community probably relates to SAF type 214, Ponderosa Pine-Larch-Douglas-Fir, and to Küchler's Type 12, Douglas Fir Forest. Lower elevations in the area fall within the *Pinus ponderosa* Zone and higher elevations within the *Pseudotsuga menziesii* (or possibly *Abies grandis*) Zone of north central Oregon (Franklin and Dyrness 1969).

The sole overstory dominant in the *Pinus/* ... tion is scanty, consisting mostly of western needlegrass (*Stipa occidentalis*) with occasional bottlebrush squirreltail (*Sitanion hystrix*) and Ross's sedge (*Carex rossii*). It typifies key winter game range in this area.

The *Pinus/Arctostaphylos* community has overstory dominance of ponderosa pine but often has moderate to abundant Douglas-fir seedlings, saplings, and poles in the understory. Grand fir (*Abies grandis*) and incense cedar (*Libocedrus decurrens*) may also be present. Ground vegetation is dominated by green manzanita, often with abundant bitterbrush, western needlegrass, bottlebrush squirreltail, and Ross's sedge.

In the *Pseudotsuga - Larix - Pinus/Arctostaphylos* community, the pine and fir are mixed with moderate amounts of western larch in the overstory. Ground vegetation is dominated by green manzanita with western needlegrass, bottlebrush squirreltail, Ross's sedge and some *Fragaria cuneifolia*.

Mammals believed to reside in or visit the natural area are listed in table MI-1. Mule deer (*Odocoileus hemionus*) use the area as winter range.

HISTORY OF DISTURBANCE

Fire-scarred ponderosa pine and the absence of dominant, old-growth Douglas-fir and grand fir indicate ground fires periodically burned nearly all portions of the tract prior to initiation of fire control programs about 1910 (fig. MI-2). Fire scars record 10 to 12 ground fire occurrences.

Domestic livestock, mainly sheep, passed through the area on their way to grazing grounds at higher elevations in earlier years. They do not appear to have significantly altered the vegetation.

On the other hand, mule deer make heavy use of the lower bench area for primary winter range. Deer apparently have or are causing some changes in ground vegetation on the bench; bitterbrush is moderately to severely browsed and many ponderosa pine saplings are highlined.

cinity of the natural area and are at partially relevant there. They include: nt analyses of vegetation on the east of the central Oregon Cascade Range cted by West (1964, 1968, 1969) and erg (1961); studies of the flora and unities on Black Butte by Sherman and Johnson (1961); and Sherman's study of spatial and chronological ns of bitterbrush as influenced by rosa pine overstory. Only Swedberg actually used the natural area as a ing site, however.

Metolius Research Natural Area pro- a variety of interesting research op- nities including: (1) determination of of game use on forested winter range y used by mule deer; (2) evaluation of pographic-vegetational changes along evational and topographic gradient a bench and up a steep, westerly slope;

graphic and elevational changes over short distances on biomass productivity.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area are: *Topography*—15' Sisters, Oregon and Whitewater River, Oregon quadrangles, scale 1: 62,500, issued by the U.S. Geological Survey in 1959 and 1961, respectively; *geology*—*Geologic Map of the Central Part of the High Cascade Range, Oregon* (Williams 1957), and *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). Either the District Ranger (Sisters Ranger District) or Forest Supervisor (Deschutes National Forest, Bend, Oregon) can provide details on the most recent aerial photo coverage of the area.

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ra	*Scapanus orarius*	coast mole
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
ra	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	western pipistrel
	Plecotus townsendi	Townsend big-eared bat
rpha	*Lepus americanus*	snowshoe hare
	Ochotona princeps	pika
a	*Clethrionomys californicus*	California red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Sciurus griseus	western gray squirrel
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys mazama	Mazama pocket gopher
	Zapus trinotatus	Pacific jumping mouse
ra	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Spilogale putorius	spotted skunk or civet cat
	Taxidea taxus	badger
	Ursus americanus	black bear
	Vulpes fulva	red fox
tyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

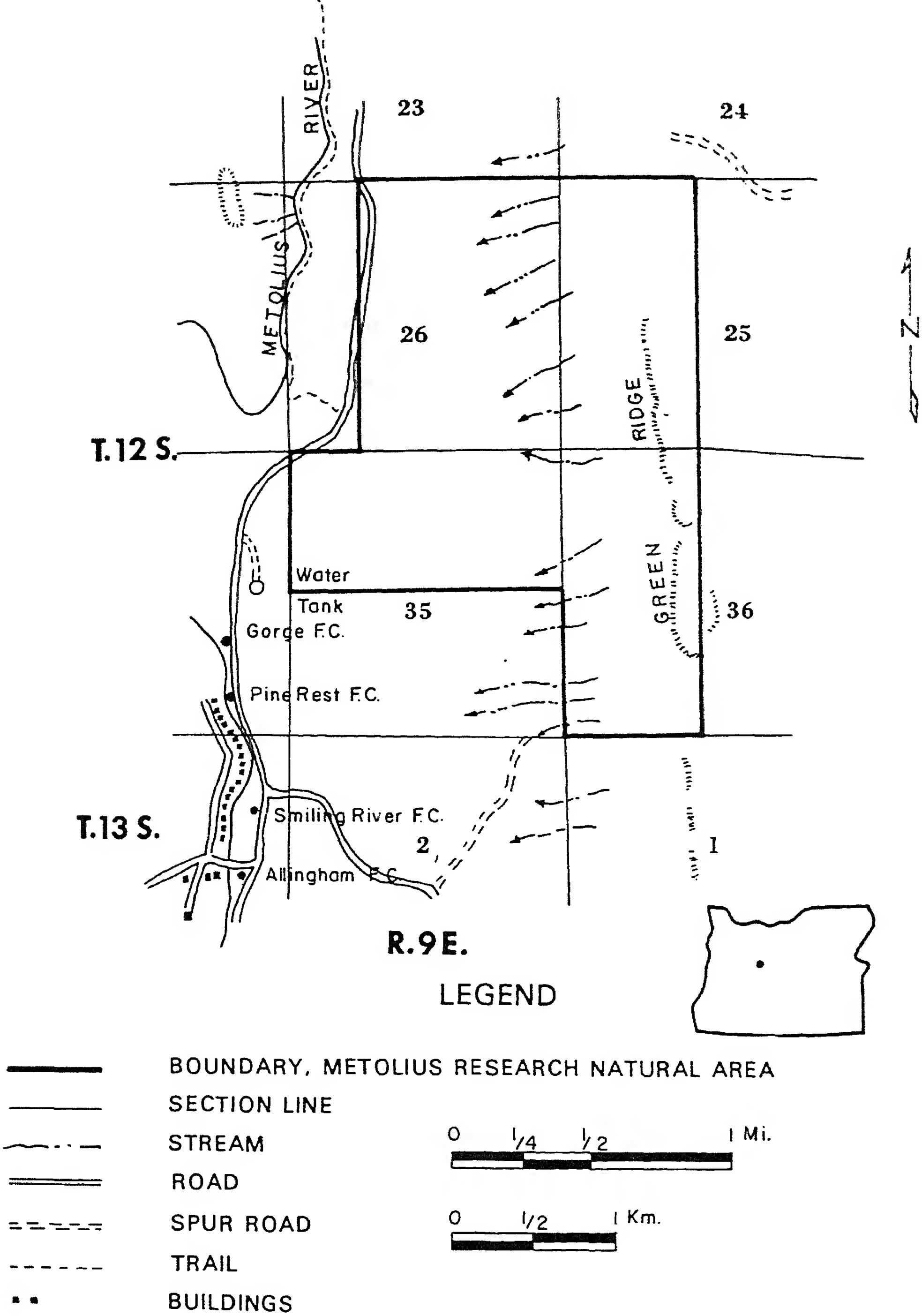

Figure MI-1.– Metolius Research Natural Area, Jefferson County, Oregon.

Figure MI-2.—Natural features of the Metolius Research Natural Area. Upper left: Flatland community of ponderosa pine, bitterbrush, and western needlegrass. Upper right: Rolling foothill community of ponderosa pine with seedling, sapling, and pole-sized Douglas-fir and an understory of bitterbrush, green manzanita, and western needlegrass. Lower left: Community of ponderosa pine, Douglas-fir, green manzanita, and western needlegrass found on steep westerly slopes. Lower right: Fire-scarred ponderosa pine located in flat portion of natural area; eight fires are recorded in this scar.


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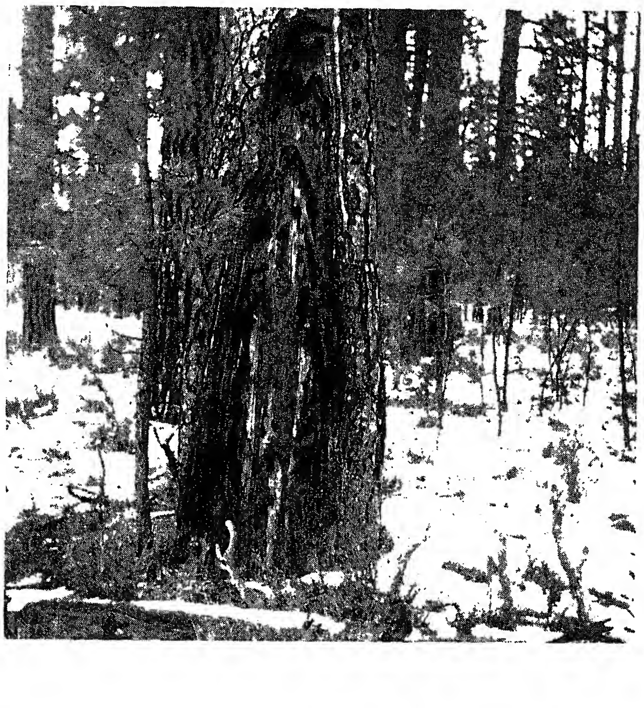

MILL CREEK RESEARCH NATURAL AREA[1]

Transitional area between forest and grassland with mosaic of Oregon white oak, ponderosa pine, Douglas-fir and bunchgrass communities on the east slope of northern Oregon's Cascade Range.

The Mill Creek Research Natural Area was established on August 16, 1971, to exemplify the community mosaic found at the forest-grassland transition on the east slope of the northern Oregon Cascade Range. It contains representative, relatively undisturbed stands of bunchgrasses, Oregon white oak (*Quercus garryana*) with an understory of grasses and sedges, and Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*). The 330-ha. (815-acre) tract is located in Wasco County, Oregon, and is administered by the Barlow Ranger District (Dufur, Oregon), Mount Hood National Forest. The irregularly shaped tract is located in portions of sections 4, 8, 9, 16, and 17, T. 1 S., R. 11 E., Willamette meridian, at 45°30′ N. latitude, 121°20′ W. longitude (fig. ML-1).

ACCESS AND ACCOMMODATIONS

Since this natural area lies within the Mill Creek drainage, the municipal watershed of the City of The Dalles, access is strictly controlled. It is necessary to obtain permission for entry and, possibly, a key from the Ranger District before entering the watershed, regardless of the approach route. This is in addition to obtaining permission to conduct research on the natural area itself.

The natural area is located about 27 km. (17 miles) west of Dufur, Oregon, and is approached by graveled county and National Forest roads. Dufur is 27 km. (17 miles) south of The Dalles on U.S. Highway 197. Access is good during the summer, but snow creates difficulties during the winter. Closest accommodations are in Dufur; developed forest camps are not convenient to the natural area.

ENVIRONMENT

The Mill Creek Research Natural Area varies in elevation from 790 to 1,040 m. (2,600 to 3,410 ft.). It is located on the gently to steeply rolling lower foothills of the east slope of the Cascade Range.

Parent rocks are grey hard basalt to grey to dark grey andesites. The area was glaciated during the Wisconsin period.

A modified marine climate prevails. Most precipitation occurs as rain or snow during the cool, cloudy winter. Summers are warm, generally low in precipitation and largely cloudless. One to 3 months of drought are common. Winds are often strong, particularly during the winter since this area is located near the mouth of the Columbia Gorge. Climatic data from The Dalles, located along the Columbia River about 24 km. (15 miles) northeast and 700 to 800 m. below the tract, are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	12.4°C. (54.4°F.)
Mean January temperature	1.1°C. (34.0°F.)
Mean July temperature	23.2°C. (73.8°F.)
Mean January minimum temperature	−2.5°C. (27.6°F.)
Mean July maximum temperature	31.1°C. (88.0°F.)
Average annual precipitation	349 mm. (14.1 in.)
June through August precipitation	23.0 mm. (0.9 in.)
Average annual snowfall	6.0 cm. (23.5 in.)

[1] Description prepared by Dr. F. C. Hall, U.S. Department of Agriculture, Forest Service, Region 6, Portland, Oregon.

he Dufur Ranger Station. Soils range from ery shallow, slightly plastic cobbly loams verlying well-fractured, dark grey, hard asalt to moderately deep, slightly plastic, reyish loamy fine sands overlying grey to ark grey andesite. These materials are well rained, of moderately rapid permeableness nd have weak surface stability.

BIOTA

Estimated areas by vegetation type are:

Name	*Area*
'orests of pole-sized Douglas-fir with mature ponderosa pine	166 ha. (410 acres)
'orests of Oregon white oak with mature ponderosa pine	126 ha. (310 acres)
Grassland	38 ha. (95 acres)
	330 ha. (815 acres)

The stands of Douglas-fir and ponderosa pine can be assigned to SAF forest cover ype 214, Ponderosa Pine-Larch-Douglas-Fir (Society of American Foresters 1954), and Küchler's (1964) Type 12, Douglas Fir Forest. The Oregon white oak stands with ponderosa pine can be assigned to SAF type 233, Oregon White Oak, and to Küchler's Type 26, Oregon Oakwoods. The grassland areas can be assigned to Küchler's Type 51, Wheatgrass-Bluegrass.

Bunchgrass communities dominate steep o moderately steep southeast slopes and many ridge tops (fig. ML-2). These openings are characterized by bluebunch wheatgrass (*Agropyron spicatum*), arrowleaf balsamroot (*Balsamorhiza sagittata*), Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa sandbergii*), with some needlegrass (*Stipa* spp.) and cheatgrass brome (*Bromus tectorum*). These communities appear similar to those described for Daubenmire's (1970) *Agropyron spicatum-Poa secunda* habitat type, lithosolic phase, but apparently include more arrowleaf balsamroot.

kinds of the Oregon white oak stands can be distinguished: those dominated by smaller trees 10-cm. (4-in.) or less d.b.h. and those dominated by trees 15-cm. (6-in.) or more d.b.h., the latter including scattered ponderosa pine. Small diameter oak stands have a crown cover of 30 to 50 percent. Ground vegetation is dominated by *Elymus glaucus* with abundant *Symphoricarpos albus*, elk sedge (*Carex geyeri*), and various forbs. Oak stands of larger diameter trees have a crown cover of 20 to 30 percent and the oaks tend to occur in groups or clumps. Ground vegetation is dominated by elk sedge with bitterbrush (*Purshia tridentata*) and some *Amelanchier alnifolia*, needlegrasses, and bluebunch wheatgrass. In these areas, bluebunch wheatgrass tends to assume a rhizomatous habit. In general, Oregon white oak stands are located on southeast and southerly slopes from ridgetops to the drainage bottom.

Stands dominated by Douglas-fir and ponderosa pine occur in swales and areas of deeper soil and on east and northeast slopes. Most ponderosa pine is mature to overmature and is generally over 50-cm. (20-in.) d.b.h., and 40 m. (120 feet) in height. The Douglas-fir is much younger and varies in diameter from 12- to 40-cm. (5- to 16-in.) d.b.h. Occasional grand fir (*Abies grandis*) and western larch (*Larix occidentalis*) are present. Ground vegetation is dominated by *Symphoricarpos albus*, elk sedge, occasional *Holodiscus discolor*, *Arnica cordifolia*, *Hieracium* spp., *Fragaria* spp., and other forbs.

A list of mammals believed to utilize the natural area as residents or transients is presented in table ML-1. Mule deer (*Odocoileus hemionus*) use the area as fall, winter, and spring range. Wild turkeys (*Meleagris merriami*) have been introduced in this area.

HISTORY OF DISTURBANCE

Fire scars on ponderosa pine indicate that ground fires periodically burned the area

1e late 1800's. The area was also grazed, ometimes heavily, by domestic livestock rior to classification of the area as municipal atershed. No logging or grazing has been arried out for the past 60 years. The cheat-rass brome on a few of the steep south-cing grasslands suggests that vegetation as altered by grazing to at least some xtent.

ESEARCH

No research is known on the area. It pro-des numerous interesting opportunities to udy relationships between flora, fauna, ant communities, and environment within mosaic of contiguous but very different nds of vegetation—bunchgrass, Oregon hite oak, and mixed conifer stands—in an ea at the forest-grassland transition.

IAPS AND AERIAL HOTOGRAPHS

Special maps applicable to the natural area clude: *Topography* — 7.5′ Five Mile Butte, regon (scale 1:24,000), and 15′ White Sal-on, Oregon - Washington (scale 1:62,500) adrangles issued by the U.S. Geological urvey in 1962 and 1967, respectively; and *ology — Geologic Map of Oregon West of e 121st Meridian,* scale 1:500,000 (Peck vide details on the most recent aerial photo coverage and forest type maps for the area.

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Peck, Dallas L.
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Society of American Foresters
1954. Forest cover types of North America (exclusive of Mexico). 67 p., illus. Washington, D.C.

U.S. Weather Bureau
1965. Climatic summary of the United States-supplement for 1951 through 1960, Washington. Climatography of the United States 96-39, 92 p., illus.

sectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
iroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis lucifugus	little brown myotis
	Plecotus townsendi	Townsend big-eared bat
gomorpha	*Lepus americanus*	snowshoe hare
dentia	*Aplodontia rufa*	mountain beaver
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	popcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Marmota flaviventris	yellow-bellied marmot
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Sciurus griseus	western gray squirrel
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys mazama	Mazama pocket gopher
	Zapus trinotatus	Pacific jumping mouse
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	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
tiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

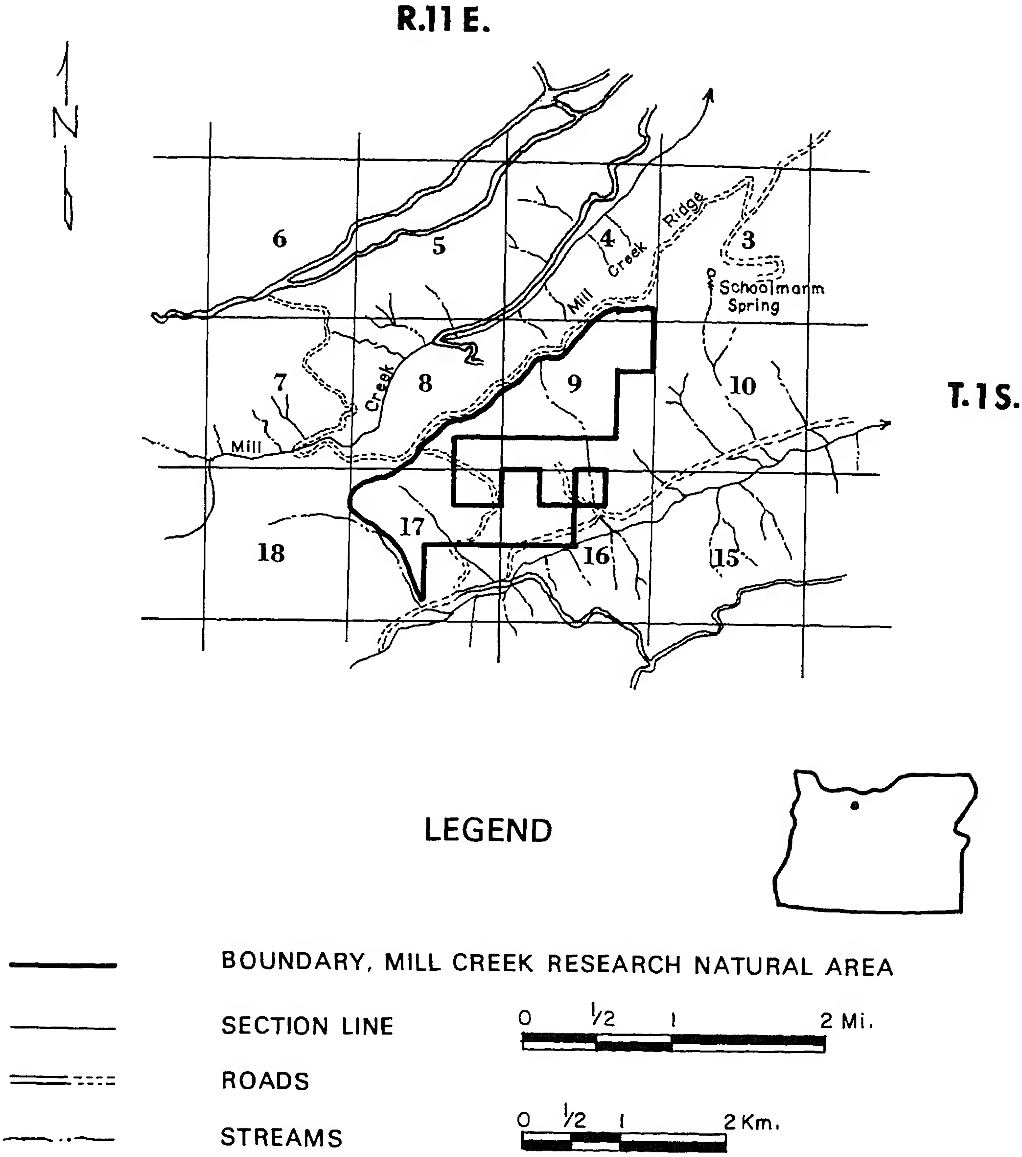

Figure ML-1.– **Mill Creek Research Natural Area, Wasco County, Oregon.**

Figure ML-2.—Plant communities in the Mill Creek Research Natural Area. Upper left: Horizontal view showing natural grassland of bunchgrasses and arrowleaf balsamroot in the foreground and forest of small size Oregon white oak and *Elymus glaucus* in the middleground with stringers of the Douglas-fir-ponderosa pine forest. The mosaic pattern of plant communities is directly related to soil characteristics; shallower soils support the grasslands. Upper right: View from a community of bunchgrass and arrowleaf balsamroot across the Mill Creek watershed showing an Oregon white oak and elk sedge stand, with occasional mature ponderosa pine, and the upper edge of Douglas-fir-ponderosa pine stand. Center left: Small Douglas-fir with *Elymus glaucus, Symphoricarpos albus,* elk sedge, and forbs as ground vegetation. Center right: Larger, clumped Oregon oak with occasional mature ponderosa pine and ground vegetation dominated by elk sedge and some bitterbrush, *Amelanchier alnifolia,* needlegrass, and bluebunch wheatgrass. Lower left: Pole-sized stand dominated by Douglas-fir with occasional old-growth ponderosa pine and ground vegetation of *Symphoricarpos albus,* elk sedge, and forbs. This community is characteristic of ridges with deeper soil and east to northeast slopes. Lower right: Cove community of Douglas-fir and ponderosa pine with *Symphoricarpos albus, Holodiscus discolor,* sedge and forbs.


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MYRTLE ISLAND RESEARCH NATURAL AREA[1]

California-laurel with scattered old-growth Douglas-fir growing on a small island in the Umpqua River.

he Myrtle Island Research Natural Area established on September 14, 1951, to serve an old-growth stand of California-rel (*Umbellularia californica*). The 11.3-ha. acre) island is located in Douglas County, gon, and is administered by the Roseburg trict (Roseburg, Oregon), Bureau of Land nagement. The natural area occupies lot section 20 and lot 11 of section 21, T. 24 R. 7 W., Willamette meridian. It lies at 29′ N. latitude and 123°34′ W. longitude.

CESS AND COMMODATIONS

rimary access is by State Highway 138 either Sutherlin or Elkton. Between July September, the island can be reached n the north shore of the river by wading MY-1). To reach the vicinity, leave te Highway 138 at Bullock Bridge, cross bridge, and turn left on Cougar Creek d. Drive along the river to the sign which ks the end of the county road (about 7.7 or 4.8 miles from the bridge); you are osite Myrtle Island at this point. To ap-ach the island by boat, leave State High-138 about 0.5 km. (0.3 miles) south of lock Bridge and drive along the Tyee Road on the south side of the Umpqua River for about 7.9 km. (4.9 miles) to a short spur road down to the riverbank. A boat can be placed in the river at this site which is a short distance upstream from the island.

Travel on the island is not difficult although there are no trails.

The nearest commercial accommodations are in Sutherlin.

ENVIRONMENT

The Myrtle Island Research Natural Area is a typical river island with a series of more or less identifiable terrace levels. Topography is gentle with the only steep slopes located along the edge of the river or as short pitches between terraces. The elevation of the natural area is about 97.5 m. (320 ft.). The surface of the island varies from about 1.5 to 12 m. (5 to 40 ft.) above water level during the summer months.

The natural area is made up of fluvial deposits of gravel, sand, and finer materials. River action is constantly changing the form of the island, eroding it in some areas and depositing new materials in others.

The natural area is located in the mild, moist climatic region typical of western Oregon. However, it is within one of the valley systems located between the Coast Ranges and Cascade Range and is, therefore, subject to the somewhat warmer and drier climate typical of these areas. The summer dry period is especially pronounced. Representative climatic data from the Roseburg weather station, which is about 32 km. (20 miles) southwest are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	12.1°C. (53.7°F.)
Mean January temperature	5.2°C. (41.1°F.)
Mean July temperature	19.9°C. (67.8F.)
Mean January minimum temperature	1.6°C. (34.9°F.)
Mean July maximum temperature	28.0°C. (82.4°F.)

[1] Description prepared by Dr. J. F. Franklin, Department of Agriculture, Forest Service, fic Northwest Forest and Range Experiment ion, Forestry Sciences Laboratory, Corvallis, on.

precipitation slightly higher on the natural area.

The soils on the natural area are all alluvial. They vary widely in stone content, texture, and depth. The best soils are found on the high terraces where stands of California laurel occur. The soils there are deep, loamy sands with no horizon development. Deposition of soil parent materials is still actively occurring all over the island. Recent depositions of coarse gravels and stones on the western point of the island and finer materials on the higher terraces probably occurred during floods in the winter of 1964-65.

BIOTA

Estimated areas by cover types are:

Name	*Area*
California-laurel-Douglas-fir	8.1 ha. (20 acres)
Other alluvial communities	3.2 ha. (8 acres)

The area seems to best fit Küchler's (1964) Type 29, California Mixed Evergreen Forest (*Quercus-Arbutus-Pseudotsuga*) and does lie within the Interior Valley (*Pinus-Quercus-Pseudotsuga*) Zone of Franklin and Dyrness (1969).

California-laurel is the most abundant single tree species present on the island. With Douglas-fir (*Pseudotsuga menziesii*) it forms dense forests on the upper, older island surfaces (fig. MY-2). Occasional bigleaf maple (*Acer macrophyllum*) and one or two western redcedar (*Thuja plicata*) and incense-cedar (*Libocedrus decurrens*) are also present. The stand in the eastern two-thirds of the forested tract has the largest and oldest trees with California laurel reaching 50- to 60-cm. (20- to 25-inches) d.b.h. and 15 to 21 m. (50 to 70 ft.) tall. The Douglas-fir average about 100-cm. (40-in.) d.b.h. and 38 to 46 m. (125 to 150 ft.) tall. The forest stand in the western third of the tract is composed of considerably smaller and younger trees.

The understory in the forested portion of *suksdorfii*, *Corylus cornuta* var. *californica*, *Acer circinatum*, *Galium triflorum*, and several species of grass. Strong successional trends are absent. Reproduction of the scattered old-growth Douglas-fir is lacking. Other tree species also do not appear to be reproducing beneath the dense canopy of California laurel. The only exception to this statement is in the California-laurel stand at the extreme eastern point of the island. In this localized area, reproduction of Oregon ash (*Fraxinus latifolia*) is scattered abundantly through the understory of *Rhus diversiloba* and *Polystichum munitum*.

A variety of open woodland, shrub, and weed communities occupies the western tip and northern shore of the island (fig. MY-2). These are for the most part lower lying areas which are subject to more frequent and severe disturbance by high waters. Included here is a stunted stand of Oregon white oak (*Quercus garryana*) and Oregon ash with a weedy understory; shrubby thickets of willows (*Salix* spp.) and white alder (*Alnus rhombifolia*); and a variety of herbaceous communities dominated by a rich collection of both native and alien grasses and weeds.

The mammals believed to utilize the natural area as residents or transients are listed in table MY-1. At one time, there was a small herd of wild angora goats which lived on the island but they are believed to have been eliminated by the flood of 1964. Several species of aquatic birds such as mallard ducks (*Anas platyrhynchos*) are found in the marshy areas adjacent to the northwest corner of the island.

HISTORY OF DISTURBANCE

Fire scars on old Douglas-fir indicate that ground fires have burned through at least part of the island sometime in the past. Axe marks also were noted in the bark of a few old-growth fir trees.

The entire island is subject to flooding

nsive disturbance of the vegetation and sition of coarse materials occurred at the ern end of the island. This flood also d some of the southern banks of the d. Damage appears to have been minor ne California-laurel stands themselves ugh debris was lodged several feet up e branches of many trees and shrubs MY-2).

EARCH

ere is no research in progress on the e Island Research Natural Area. As nly island in the regional research al area system, it offers special op- nities to study soil and vegetation pment in relation to geomorphological sses. The general sparsity of ground ation under the groves of California- , coupled with the high content of atic compounds in leaves and litter of pecies, suggests the area may also be a field site for allelopathic studies.

PS AND AERIAL OTOGRAPHS

cial maps and most recent photographs ble are the following: *Topography*— vee, Oregon quadrangle, scale 1:62,500, 1961). The District Manager (Roseburg District), Bureau of Land Management, can provide details on the most recent aerial photo coverage and forest type maps for the area.

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	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex pacificus	Pacific shrew
	Sorex trowbridgii	Trowbridge shrew
hiroptera	*Antorzous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
agomorpha	*Sylvilagus bachmani*	brush rabbit
odentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys californicus	California red-backed vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma fuscipes	dusky-footed wood rat
	Peromyscus maniculatus	deer mouse
	Sciurus griseus	western gray squirrel
	Tamiasciurus douglasi	chickaree
arnivora	*Bassariscus astutus*	ringtail or miner's cat
	Canis latrans	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
rtiodactyla	*Odocoileus h. columbianus*	black-tailed deer

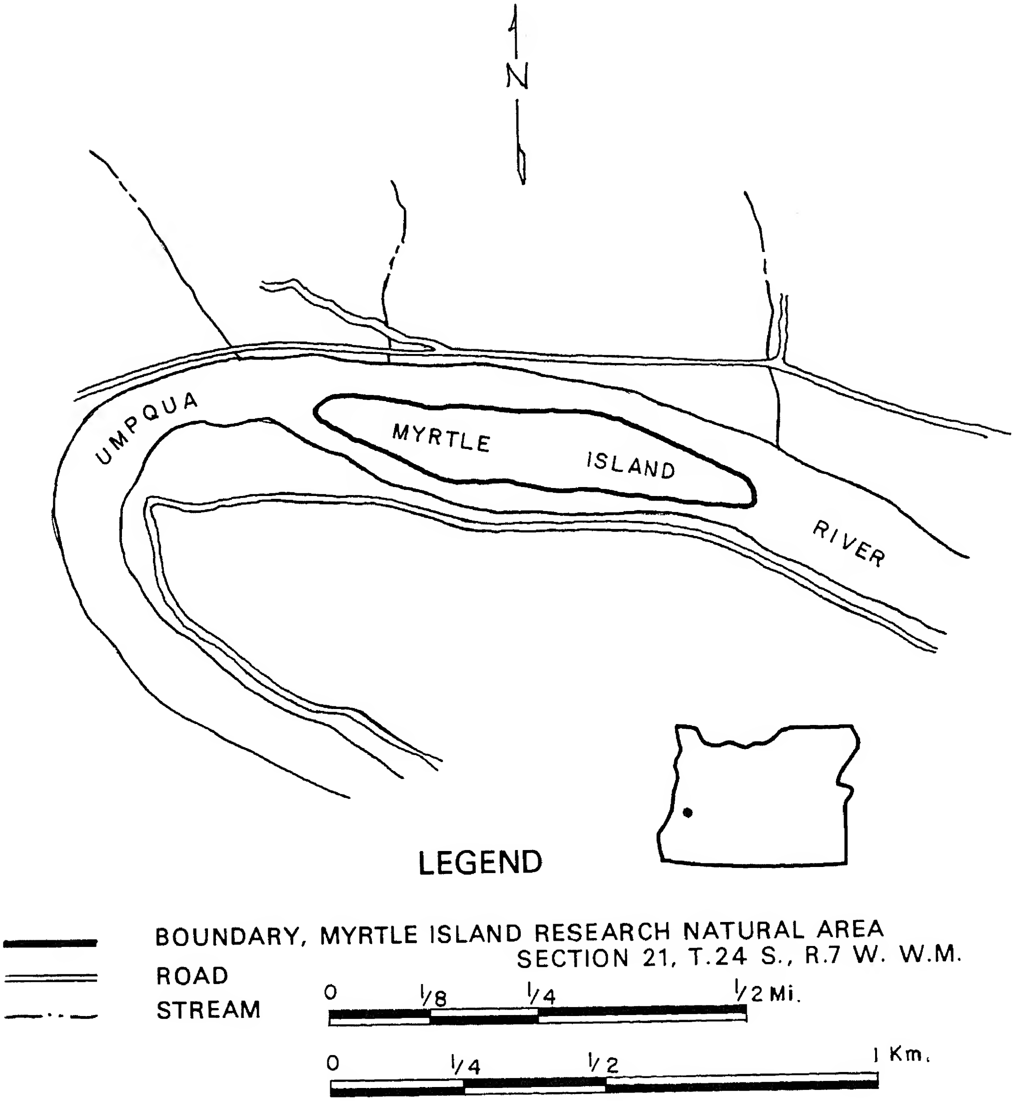
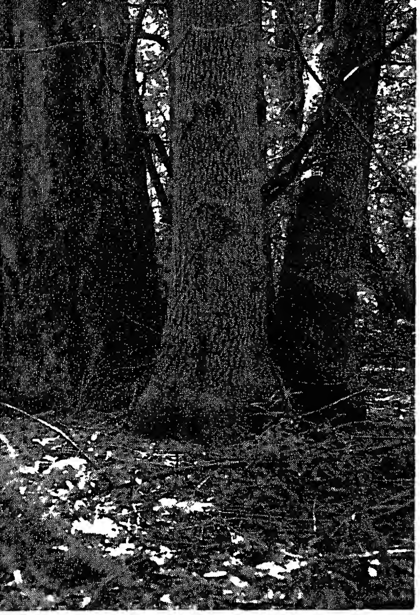
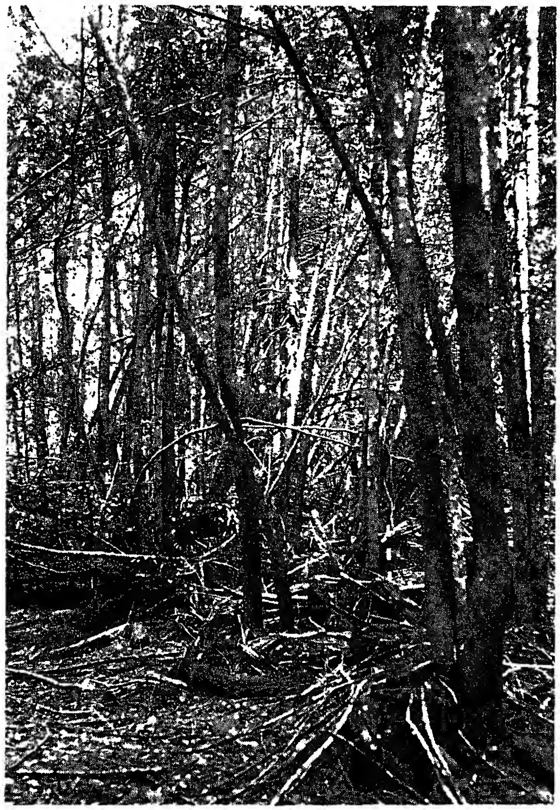


Figure MY-1.– Myrtle Island Research Natural Area, Douglas County, Oregon.

Figure MY-2.—Communities of the Myrtle Island Research Natural Area. Upper left: Old-growth Douglas-fir and California-laurel with a sparse understory typical of most of the island stands. Upper right: Grove of California-laurel with relatively dense understory of *Polystichum munitum.* Lower left: Seral shrub and herb community growing on stony materials deposited at the west end of the island in 1964. Lower right: Young stand of California-laurel showing damage suffered and debris deposited by flood waters.





NESKOWIN CREST ESEARCH NATURAL AREA[1]

itka spruce and western hemlock rowing on a headland immediately djacent to the Pacific Ocean.

Neskowin Crest Research Natural was established on October 26, 1941, as ample of Sitka spruce (*Picea sitchen-* estern hemlock (*Tsuga heterophylla*) growing adjacent to the ocean. The a. (686-acre) tract is located in Tilla- County, Oregon, and is administered Hebo Ranger District (Hebo, Oregon), .w National Forest. It is also a part of ascade Head Experimental Forest, a ha. (11,890-acre) area maintained by Pacific Northwest Forest and Range iment Station for research and demon- on of management techniques in coastal -hemlock forest (Madison 1957). The al area occupies all of section 2 except ⁄½ NW¼ SW¼ and the W½ W½ tion 1, T. 6 S., R. 11 W., Willamette ian (fig. NC-1). It lies at 45°05′ N. de and 124°00′ W. longitude.

ESS AND OMMODATIONS

ess is via U.S. Highway 101 between unction and Neskowin. A maintained No. 1303, traverses the west half of the l area entering it from the south. To this trail, turn west off U.S. Highway nto Forest Road S61 at the Cascade Head summit. Continue on Forest Road S61 for about 6 km. (3.7 miles) to its junction with Forest Road S61K. Turn right on Road S61K and follow it for 0.3 km. (0.2 mile) to the trail head. Trail 1303 enters the south-western corner of the natural area about 1.6 km. (1 mile) from the trail head; the entry point is presently unmarked. The southeastern corner of the natural area can conveniently be reached via Forest Roads S61, S61J, S61B, and a short cross-country walk. Follow Road S61 west for about 4 km. (2.45 miles) from U.S. Highway 101 and turn right on Road S61J for 0.5 km. (0.3 miles) to reach Road S61B. Leave Road S61B after approximately 0.3 km. (0.2 mile) and walk north-westerly along a definite ridge top to reach the natural area.

Numerous commercial accommodations are available at Neskowin 1.6 km. (1 mile) north and at Lincoln City, about 14 km. (9 miles) south. Neskowin Creek Forest Camp is located along the Neskowin scenic drive (old U.S. 101) within the experimental forest.

ENVIRONMENT

The Neskowin Crest Research Natural Area is topographically rugged. It occupies part of a headland which is dissected by numerous drainages. Along the northwest boundary, it plunges abruptly into the ocean in a series of cliffs. Topography is gentle only along major ridgetops; slopes are steep. Elevations range from sea level to over 427 m. (1,400 ft.) at the southeast corner. The tops of the ocean cliffs — the lowest forested elevations — are 45 to 75 m. (150 to 250 ft.) in elevation. Numerous small permanent streams rise within the natural area, and drainages of several larger ones lie wholly or predominantly within the natural area.

The natural area lies entirely on volcanic bedrock, alkalic basalt flows, breccias, and

[1] cription prepared by Dr. J. F. Franklin, U.S. nent of Agriculture, Forest Service, Pacific est Forest and Range Experiment Station, For- ciences Laboratory, Corvallis, Oregon.

sedimentary formations. However, there appears to be a capping of marine tuffaceous siltstone over the basalt bedrock in most locations; basaltic outcrops are generally confined to ocean cliffs.

The western Oregon marine climate is extremely pronounced in this oceanside natural area. It is wet and cool; seasonal and diurnal fluctuations in temperature are minimal. Strong ocean winds sweep the area. Although the bulk of precipitation occurs in the winter, a summer drought period is absent. A dominant climatic phenomenon is the summer fog which envelops the headland on most warm summer days. These fogs condense on tree crowns and fall to the ground as "fog-drip." A study of precipitation in forests and in openings on Cascade Head near the natural area indicated a 26-percent increase in precipitation under stands due to fog-drip (Ruth 1954). The following climatic data are from the nearest climatic station at experimental forest headquarters (listed as Otis 2 NE in U.S. Weather Bureau 1965):

Mean annual temperature	13.3°C. (50.6°F.)
Mean January temperature	5.3°C. (41.5°F.)
Mean July temperature	15.3°C. (59.6°F.)
Mean January minimum temperature	2.2°C. (35.9°F.)
Mean July maximum temperature	20.9°C. (69.7°F.)
Average annual precipitation	2,496 mm. (98.26 in.)
June through August precipitation	163 mm. (6.42 in.)

Additional climatic data for this station and the vicinity are available in Ruth (1954). Since the weather station is lower in elevation and farther inland, temperatures are probably somewhat cooler and precipitation higher (especially when fog-drip is included) on the natural area.

Soils in the natural area have not been mapped or classified into series; however, profiles examined can be best characterized as Astoria-like Sols Bruns Acides. They have developed primarily from tuffaceous siltstones O2; 5- to 10-cm. very dark brown silt loam A11; 7- to 23-cm. dark brown A12; 15- to 40-cm. dark yellowish-brown silty clay loam A3 or B1; 15- to 80-cm. dark yellowish-brown silty clay loam B2; and a B3 or C horizon, or both. Surface soils are strongly acid (e.g., pH 5.3), high in organic matter (e.g., > 20 percent) and total nitrogen (e.g., 0.50 percent), and low in percent base saturation (e.g., 10 percent).

BIOTA

Estimated area by SAF cover types (Society of American Foresters 1954) are:

No.	*Name*	*Area*
224	Western Hemlock	162 ha. (400 acres)
225	Sitka Spruce-Western Hemlock	105 ha. (259 acres)
223	Sitka Spruce	11 ha. (27 acres)

The area falls entirely within Küchler's (1964) Type 1, Spruce-Cedar-Hemlock Forest and the *Picea sitchensis* Zone of Franklin and Dyrness (1969).

Only two tree species are present in significant numbers — Sitka spruce and western hemlock. Occasionally red alder (*Alnus rubra*) and rarely Douglas-fir (*Pseudotsuga menziesii*) are encountered in the spruce-hemlock stands. Large old Sitka spruce, which average around 215-cm. (85-in.) d.b.h. and 73 m. (240 ft.) in height, are the most impressive specimens. These trees are over 250 years of age. The bulk of the forest is composed of spruce and hemlock about 120 years old, 75-to 100-cm. (30- to 40-in.) d.b.h., and 60 m. (200 ft.) tall (fig. NC-2). Over most of the natural area, both age classes are intermixed with old growth scattered through younger stands.

Successional processes are obvious throughout the natural area. Large old spruce are being windthrown or having their tops broken out. Large limbs broken from tops and windthrown trees showing extensive butt rot are

d with hemlock poles and saplings (fig.). Under denser stands, the proportion nlock to spruce seedlings is even higher.

e composition of the understory is quite rm throughout the natural area. *Men- ferruginea*, *Polystichum munitum*, *s oregana*, *Maianthemum bifolium* var. *chaticum*, *Montia sibirica*, and *Eurhyn- oreganum* are the constant and char- stic species (fig. NC-2). Less common s include *Vaccinium parvifolium*, *Clin- uniflora*, *Rubus ursinus*, *Melica subula- rillium ovatum*, *Tiarella trifoliata*, *T. iata*, *Galium triflorum*, and *Luzula lora*. *Gaultheria shallon* is relatively nmon in the natural area, occurring y on rotten logs or stumps (fig. NC-2) t along the ocean cliffs where it is some- an understory dominant. On the lower , along streams, and in seep areas, a tangle of shrubs and herbs develops, ling the following as well as the afore- oned species: *Oplopanax horridum*, *s spectabilis*, *R. parviflorus*, *Blechnum t*, *Ribes bracteosum*, *Dryopteris dilata- mbucus melanocarpa*, *Athyrium filix- a*, *Disporum smithii*, and *Stachys ameri- Carex obnupta*, *Corydalis scouleri*, *itum americanum*, and *Chrysosplenium maefolium* typify swampy areas.

and forest openings are encountered are completely choked with shrubs such *bus spectabilis*, *Menziesia*, and *Sambu- g*. NC-2). Tree regeneration under these shrub layers is often sparse or absent.

e mammals which are known or prob- nhabitants of the natural area are listed le NC-1. A varied avifauna is associated the ocean cliffs along the northwest ary of the natural area, and northern ons (*Eumetopias jubata*) frequent the nt ocean.

eamsides and ocean cliffs are the only orthy specialized habitats.

to at least occasional fires, the last major one occurring about 1845. During recent years, winter windstorms have been the most important agent of natural disturbance. Most of the damage has occurred along the southern boundary, but severe east winds in 1971 did break many old-growth Sitka spruce at 2 to 5 m. (6 to 15 feet) above ground line all through the natural area. There is no evidence of human disturbance in the natural area.

RESEARCH

Some observational research on the fauna and plant communities is currently being conducted on the natural area. At the time the natural area was cruised (1934), a map was prepared showing the location of all large Sitka spruce specimens. Copies of this map are on file at the Pacific Northwest Forest and Range Experiment Station.

The natural area and its environs do offer some special research opportunities. The natural area is adjacent to the Neskowin Crest Scenic Area, an oceanside strip of ocean cliffs, forest, and natural grassy openings which will be maintained in a near-natural state primarily for recreational purposes. The Nature Conservancy's Cascade Head preserve is also nearby. There is, therefore, the possibility of utilizing the natural area as a part of ecological studies on this oceanside complex. The flora and plant communities of a small natural headland prairie adjacent to the southwest edge of the natural area (Hart Cape) have already been studied (Davidson 1967).

Neskowin Crest Research Natural Area is also a part of the Cascade Head Experimental Forest, much of which is similar in forest type and environment. The possibility exists of using other parts of the experimental forest for work involving destructive sampling or manipulation and using the natural area as a control site.

quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1955; and *geology*—*Geology of the Coastal Area Between Cape Kiwanda and Cape Foulweather, Oregon*, scale 1:62,500 (Snavely and Vokes 1949), *Geologic Sketch of Northwestern Oregon*, scale 1:500,000 (Snavely and Wagner 1964), and *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). Either the District Ranger (Hebo Ranger District) or Forest Supervisor (Siuslaw National Forest, Corvallis, Oregon) can provide details on the most recent aerial photo coverage and forest type maps for the area.

Copies of a topographic map (scale 8 in. = 1 mile, 50-ft. contour interval) of Cascade Head Experimental Forest, including Neskowin Crest Research Natural Area, which was prepared by Forest Service personnel in 1934, are on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. Records of a 1934 cruise of the area and a map showing location of old-growth Sitka spruce are also on file there.

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pialia	*Didelphis marsupialis*	opossum
vora	**Neürotrichus gibbsi*	shrew mole
	**Scapanus orarius*	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	**Sorex trowbridgii*	Trowbridge shrew
	Sorex vagrans	wandering shrew
	**Sorex yaquinae*	Yaquina shrew
tera	*Antrozous pallidus*	pallid bat
	**Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	**Lasiurus cinereus*	hoary bat
	**Myotis californicus*	California myotis
	**Myotis evotis*	long-eared myotis
	**Myotis lucifugus*	little brown myotis
	**Myotis thysanodes*	fringed myotis
	**Myotis volans*	long-legged myotis
	**Myotis yumanensis*	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
orpha	**Lepus americanus*	snowshoe hare
	Sylvilagus bachmani	brush rabbit
tia	**Aplodontia rufa*	mountain beaver
	Arborimus albipes	white-footed vole
	Arborimus longicaudus	red tree vole
	**Clethrionomys californicus*	California red-backed vole
	Erethizon dorsatum	porcupine
	**Eutamias townsendi*	Townsend chipmunk
	**Glaucomys sabrinus*	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	**Microtus oregoni*	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	**Peromyscus maniculatus*	deer mouse
	**Tamiasciurus douglasi*	chickaree
	Thomomys mazama	Mazama pocket gopher
	**Zapus trinotatus*	Pacific jumping mouse
vora	**Canis latrans*	coyote
	**Lynx rufus*	bobcat
	Martes americana	marten
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	**Spilogale putorius*	spotted skunk or civet cat
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
lactyla	**Odocoileus h. columbianus*	black-tailed deer

tation verified by sign, sighting, or collection.

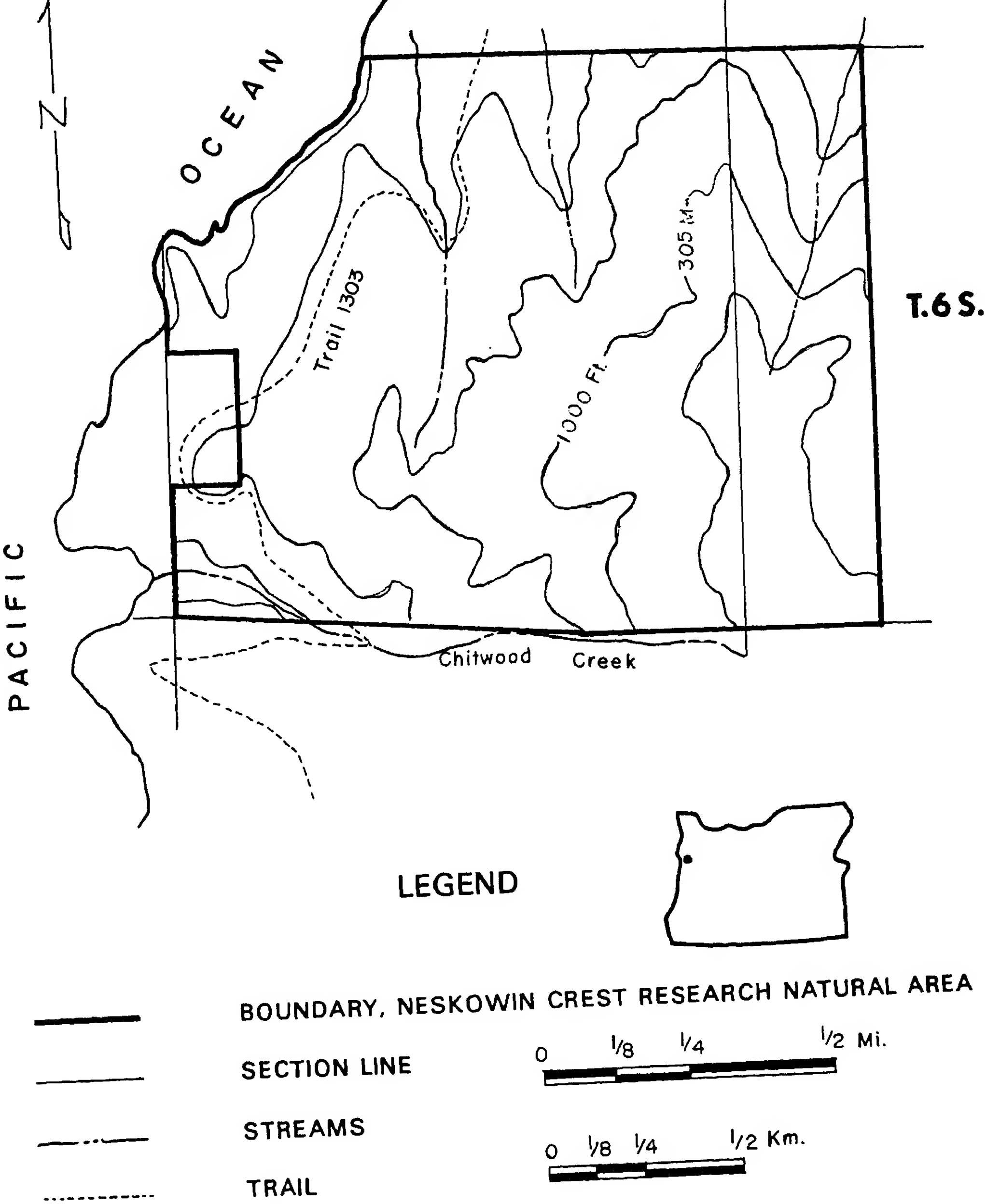
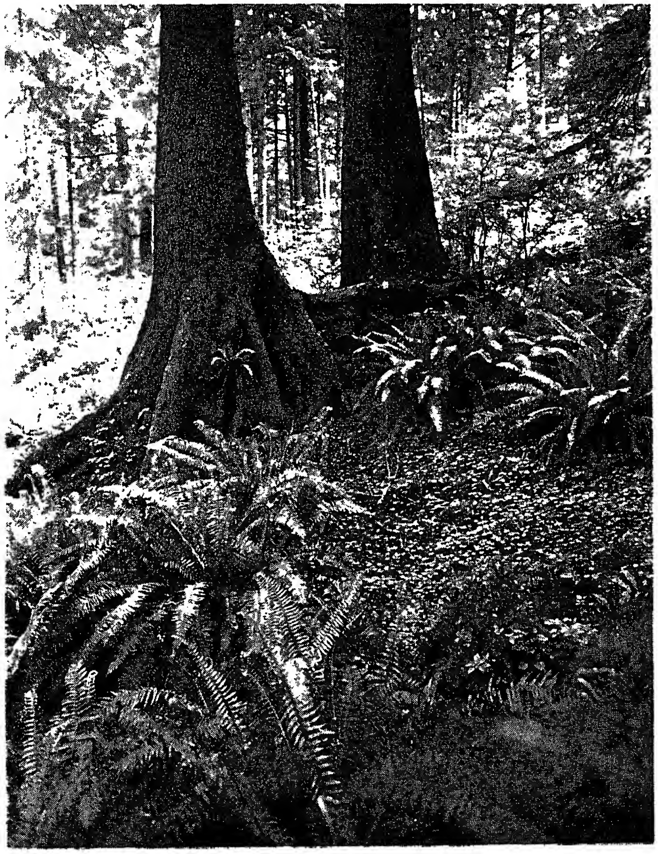


Figure NC-1.– Neskowin Crest Research Natural Area, Tillamook County, Oregon.

Figure NC-2.—Communities in the Neskowin Crest Research Natural Area. Upper left: Small opening choked with *Rubus spectabilis, Menziesia ferruginea,* and *Sambucus melanocarpa* up to 3 m. in height. Upper right: *Gaultheria shallon* growing on rotting stump. Lower left: Open stand of western hemlock and Sitka spruce with abundant regeneration of western hemlock. Lower right: 120-year-old Sitka spruce growing on rotting log with typical *Polystichum munitum-Oxalis oregana* understory.



NORTH FORK
OOKSACK RESEARCH
NATURAL AREA[1]

d-growth Douglas-fir, western mlock, and western redcedar owing on steep mountain slopes the Northern Cascades of Washgton.

North Fork Nooksack Research Narea was established on April 10, 1934. n example of the Douglas-fir (*Pseudo-nenziesii*) - western hemlock (*Tsuga hylla*) forests found at midelevations northern Cascade Range. The 605-ha. acre) tract is located in Whatcom , Washington, and is administered by acier Ranger District (Glacier, Wash- , Mount Baker National Forest. It is d on the south by State Highway 542, east by Welcome Creek, on the north thern boundary line of sections 33, 34, and sections 26, 27, and 28, T. 40 N., , and on the west by the line between /2 and E1/2 of the NW1/4 of section 40 N., R. 8 E. (fig. NF-1). The natural herefore, includes parts of sections 33, and 36, T. 40 N., R. 8 E., and section 9 N., R. 8 E., Willamette meridian. It 48°54′ N. latitude and 121°45′ W. de.

ESS AND OMMODATIONS

h Fork Nooksack Research Natural s reached via State Highway 542, the Baker Highway. It lies about 16 and 51 km. (10 and 32 miles) east of Glacier and Bellingham, Washington, respectively.

The natural area has no trails or roads within its boundaries. State Highway 542 bounds it for about 5 km. (3 miles). Remnants of an abandoned way trail may be found along the west boundary. A logging road cuts diagonally for about one-fourth mile across the extreme southeast corner of the area. At present the only way to penetrate the area is by traveling cross country. Care is required because of rock bluffs and the steep slopes. High elevations in the eastern portion of the tract are best reached via the Welcome Pass trail about 1 km. (0.5 mile) to the northeast and cross-country travel through subalpine meadows to the natural area itself.

Commercial accommodations are available in Bellingham or, to a limited extent, at Glacier. There are several public campgrounds in the vicinity along State Highway 542.

ENVIRONMENT

The North Fork Nooksack Research Natural Area covers a broad elevational span on the steep, south-exposed slope of a major mountain ridge. Elevations vary from 580 m. (1,900 ft.) along the highway to over 1,585 m. (5,200 ft.) along the northern boundary in section 35. Steep, broken slopes of 40 to 80 percent or more are common. Rock bluffs and small benches are occasionally encountered. The largest areas of gentle topography are the benches along portions of the highway and another near the center of section 35. O'Leary Creek, flowing through a rocky drainage and avalanche track (fig. NF-2), bisects the natural area. Welcome Creek forms the eastern boundary. Numerous seep areas and intermittent streams are present.

Geologically, the natural area is reportedly composed of sedimentary rocks (graywacke, argillite, and siltstones) of Upper Jurassic and Lower Cretaceous age (Huntting et al.

[1] ription prepared by Dr. J. F. Franklin, U.S. ent of Agriculture, Forest Service, Pacific st Forest and Range Experiment Station, Sciences Laboratory, Corvallis, Oregon.

A wet, cool maritime climate prevails. Annual precipitation is heavy with maxima in December and January and minima in July and August. Summers are generally cool with frequent cloudy days, but only about 10 percent of the annual precipitation occurs from June through August. Annual snowfall increases rapidly with elevation. Climatic conditions can be interpolated from data for the Glacier and Mount Baker Lodge stations, 13 km. (8 miles) west and 8 km. (5 miles) southeast, respectively (U.S. Weather Bureau 1956, 1965):

	Glacier R. S.	*Mt. Baker Lodge*
Elevation	286 m. (937 ft.)	1,266 m. (4,150 ft.)
Mean annual temperature	8.4°C. (47.2°F.)	4.5°C. (40.1°F.)
Mean January temperature	-0.3°C. (31.4°F.)	-2.6°C. (27.3°F.)
Mean July temperature	16.9°C. (62.5°F.)	12.1°C. (53.8°F.)
Mean January minimum temperature	-4.0°C. (24.8°F.)	-5.7°C. (21.8°F.)
Mean July maximum temperature	24.7°C. (76.5°F.)	17.5°C. (63.5°F.)
Average annual precipitation	1,474 mm. (58.03 in.)	2,821 mm. (111.08 in.)
June through August precipitation	155 mm. (6.09 in.)	313 mm. (12.32 in.)
Average annual snowfall	106 cm. (41.9 in.)	1,398 cm. (550.3 in.)

Unpublished precipitation data for the Shuksan weather station, 0.8 km. (0.5 mile) east of the southeast corner of the natural area, can be obtained from the U.S. Weather Bureau.

Soils on the natural area have recently been mapped by U.S. Forest Service personnel as part of a soil survey of the Mount Baker National Forest (Snyder and Wade 1970). At lower elevations, along the southern boundary of the area, soils are derived [...] grades into a very gravelly loamy sand subsoil at 55 to 75 cm. (22 to 30 in.). Soils in the northern portion of the area are classed as coarse loamy, mixed Typic Ferrods. According to the map, the northeastern section is occupied by soils derived from metasedimentary or metavolcanic rocks, and the northwestern portion contains soils derived from highly fractured igneous rocks, such as andesite. These soils have dark reddish brown to brown loam surface layers underlain by very gravelly loam to sandy loam at depths ranging from 25 to 55 cm. (10 to 22 in.).

BIOTA

Areas by SAF forest types (Society of American Foresters 1954), so far as can be determined from the original inventory, are as follows:

No.	*Name*	*Age*	*Area*	
230	Douglas-Fir — Western Hemlock	Old	195 ha.	(482 acres)
230	Douglas-Fir — Western Hemlock	Young	54 ha.	(133 acres)
227	Western Redcedar - Western Hemlock	Old	177 ha.	(437 acres)
224	Western Hemlock	Old	120 ha.	(296 acres)
221	Red Alder		2 ha.	(4 acres)
			548 ha.	(1,352 acres)

There are, in addition, 58 ha. (143 acres) classed as nonforested. This includes rock outcrops, subalpine meadow areas, and streamside brush fields. Vegetation types, as defined by Küchler (1964) appear to include: Type 2, Cedar - Hemlock - Douglas Fir Forest; Type 3, Silver Fir - Douglas Fir Forest; Type 4, Fir - Hemlock Forest; and Type 52, Alpine Meadows and Barren. The natural area spans three major vegetation zones (Franklin and Dyrness 1969) — the *Tsuga heterophylla*, *Abies amabilis*, and *T. mertensiana* Zones. The *T. mertensiana* Zone is most poorly represented occurring only at highest elevations.

The major tree species are Douglas-fir,

tered at highest elevations. Red alder rubra) and black cottonwood (*Populus arpa*) are sporadically represented in eas and along streams.

bulk of the natural area is occupied xed old-growth forests of Douglas-fir, n hemlock, and western redcedar grow- moderate to steep slopes. In these the Douglas-fir are scattered veterans 175-cm. (50- to 70-in.) d.b.h. and ex- g 600 years in age. These specimens e five to 10 per acre and make up 30 percent of the forest volume. Western k and western redcedar are more ous, but they are generally smaller and younger. Succession in these is toward a climax forest of western k. It is the only species reproducing n significant numbers (fig. NF-2). Typi- erstory species are *Polystichum muni- erberis nervosa*, *Linnaea borealis*, Paci- v (*Taxus brevifolia*), *Viola semper- Chimaphila umbellata*, and *Pyrola Acer circinatum* is scattered but locally nt. On driest slopes, *Pyrola asarifolia ultheria shallon* are found.

young-growth forests dominated by s-fir and western hemlock occur as patches and stringers. They are most ve along the western edge of the area.

fferent community is found on cool, benches at lower elevations within the area (fig. NF-2). The overstory con- western hemlock, Douglas-fir, western ar, and Pacific silver fir. Reproduction s of hemlock and Pacific silver fir indi- the climax forest will include at least ntage of both. The understory is much including *Vaccinium alaskaense*, *Cor- nadensis*, *Rubus pedatus*, *Clintonia a*, *Oplopanax horridum*, *Athyrium filix- Blechnum spicant*, *Polystichum mu- Tiarella unifoliata*, and *Gymnocarp- ryopteris*.

igher elevations, within the *Abies s* Zone, the Douglas-fir and western climax species; hemlock reproduction is sparse. Typical understory species are *Cornus canadensis*, *Rubus pedatus*, *Clintonia uniflora*, *Vaccinium alaskaense*, and *Tiarella unifoliata*.

Finally, above about 1,375 m. (4,500 ft.), mountain hemlock replaces western hemlock as the major Pacific silver fir associate. These stands vary in understory characteristics from a relatively dense condition with well-developed, ericaceous shrub layers to a relatively open condition with a herbaceous understory. Subalpine meadows of varying type are associated with these stands but have not been examined in detail (fig. NF-2).

Mammals believed to utilize the tract as transients or residents are listed in table NF-1.

HISTORY OF DISTURBANCE

Human disturbance of the natural area has been and will probably continue to be minor because of its rugged and inaccessible character. Removal of dead or hazardous trees has been carried out along the highway. A short nature trail from the highway to the base of several large trees has periodically been opened and human visitation has been confined to a hectare or so in this vicinity.

Recent natural disturbances appear to have affected only limited areas within the tract. The occurrence of young stands of Douglas-fir indicates that portions of the natural area have been burned by wildfires during the last century. Avalanches have occurred in at least one drainage — that of O'Leary Creek.

RESEARCH

The North Fork Nooksack Research Natural Area has been used as a sampling site in a study of the amount and composition of forest floors under medium-altitude, old-growth coniferous forests in Washington (Gessel and Balci 1965). No additional research is presently known to be in progress.

opportunities for research concerned with environmental gradients.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Mount Shuksan, Washington, and Mount Baker, Washington, quadrangles, scale 1:62,500, issued by the U.S. Geological Survey in 1953 and 1952, respectively; and *geology* — *Geologic Map of Washington*, scale 1:500,000 (Huntting et al. 1961). Either the District Ranger (Glacier Ranger District) or Forest Supervisor (Mount Baker National Forest, Bellingham, Washington) can provide details on the most recent aerial photo coverage and forest type maps for the area.

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1965. Climatic summary of the United States — supplement for 1951 through 1960, Washington. Climatography of the United States 86-39, 92 p., illus.

	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex cinereus	masked shrew
	Sorex obscurus	dusky shrew
	Sorex palustris	northern watershrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
ra	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis keeni	Keen myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
pha	*Lepus americanus*	snowshoe hare
	Ochotona princeps	pika
	Aplodontia rufa	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Marmota caligata	hoary marmot
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood rat
	Ondatra zibethicus	muskrat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Synaptomys borealis	northern bog vole
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
a	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Gulo luscus	wolverine
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
	Vulpes fulva	red fox
yla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer
	Oreamnos americanus	mountain goat

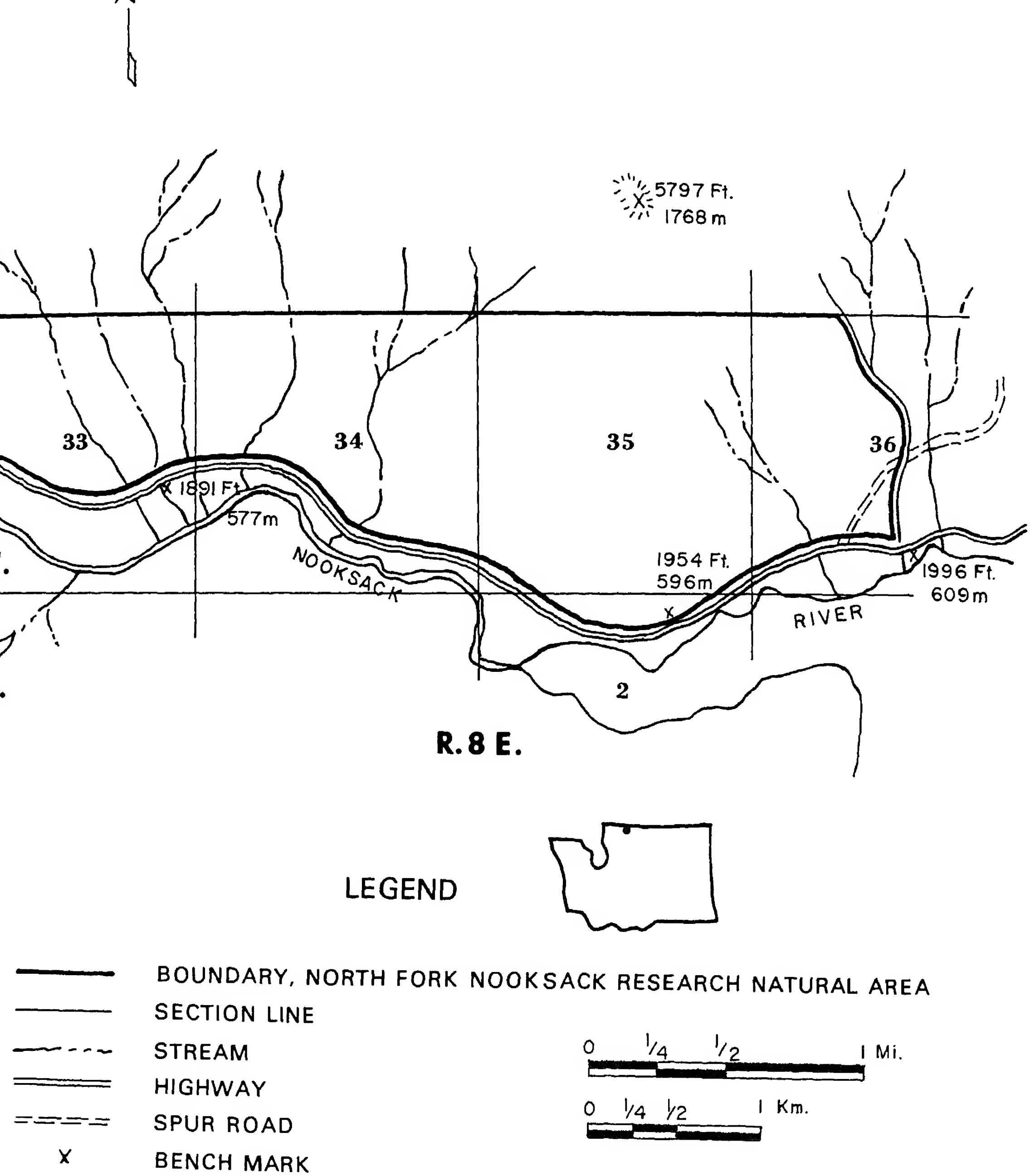
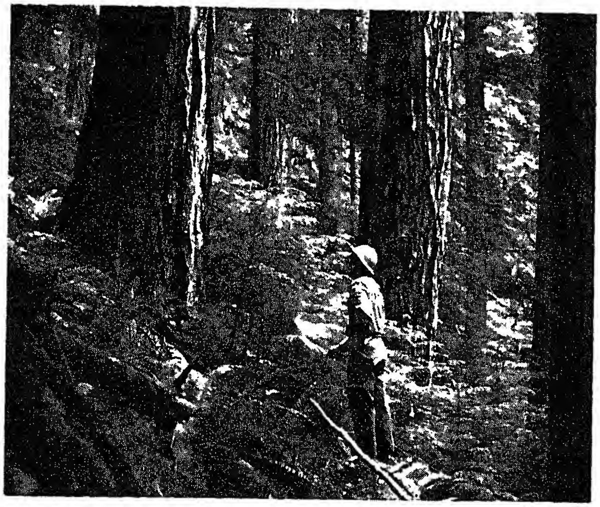
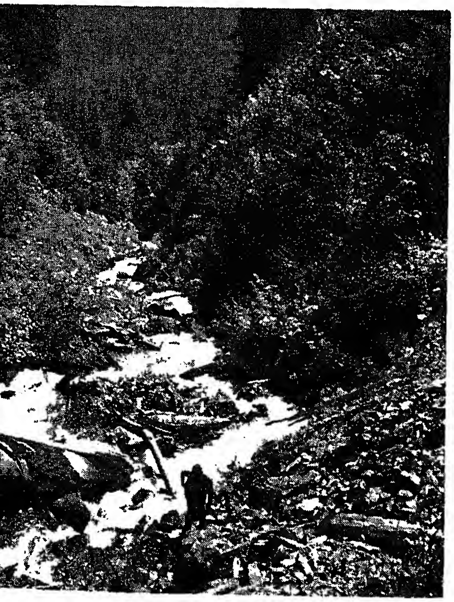


Figure NF-1.– North Fork Nooksack Research Natural Area, Whatcom County, Washington.

Figure NF-2.—Natural features of the North Fork Nooksack Research Natural Area. Upper left: Mixed stand of old-growth Douglas-fir, western redcedar, western hemlock, and Pacific silver fir on moist bench at low elevation in the natural area. Upper right: Dense reproduction of western hemlock, with smaller amounts of Pacific silver fir and western redcedar, developing in a small opening created by windthrow. Center left: Subalpine meadows and central portion of the natural area from the northern boundary; clearcuts are outside southern boundary. Center right: Typical old-growth Douglas-firs. Lower left: View down O'Leary Creek drainage which bisects the natural area, illustrating the steep stream gradient. Lower right: A portion of the upper drainage of O'Leary Creek showing damage caused by recurrent avalanches.





OCHOCO DIVIDE
ESEARCH NATURAL
AREA[1]

terior mixed conifer (ponderosa ne, Douglas-fir, grand fir, and estern larch) forests and moun- in meadows typical of central Ore- n's Blue Mountains.

Ochoco Divide Research Natural Area ablished in July 1935 to exemplify the of ponderosa pine (*Pinus ponderosa*) uglas-fir (*Pseudotsuga menziesii*) and nd fir (*Abies grandis*), western larch *occidentalis*), and Douglas-fir, char- tic of midelevations in the Blue Moun- f central Oregon. The 777-ha. (1,920- ract is located in Wheeler County, , and is administered by the Big Sum- anger District (Prineville, Oregon), National Forest. Its roughly rectan- hape includes portions of sections 28, 31, and 33 and all of section 32, T. 12 S., E., Willamette meridian. It is located 0′ N. latitude, and 120°20′ W. longi- g. OD-1).

ESS AND OMMODATIONS

natural area is located about 48 km. les) northwest of Prineville on U.S. ay 26 or about 14 km. (9 miles) north- Ochoco Ranger Station on Forest 1222 and 1204. Forest Road 1204 through the southeastern corner of t. Access is good during summer, but reates difficulties during the winter. Public accommodations are available in Prineville or in primitive forest camps in the vicinity of the natural area.

[1] iption prepared by Dr. F. C. Hall, U.S. ent of Agriculture, Forest Service, Region 6, , Oregon.

ENVIRONMENT

The Ochoco Divide Research Natural Area varies in elevation from 1,250 to 1,650 m. (4,100 to 5,400 ft.). Topography varies from undulating to rolling. The tract is located at the upper edge of an uplifted plateau and is underlain primarily by Clarno formation materials (Baldwin 1964). These late Eocene to early Oligocene deposits include rhyolite and basalt flows, tuffs and breccias, as well as some tuffaceous sedimentary rocks.

A modified continental climate prevails. Most precipitation occurs as snow during the cool, partly cloudy winter. Summers are warm, generally low in precipitation and largely cloudless. One to 3 months of drought are common. Climatic data from Ochoco Ranger Station located at 1,200 m. (3,980 ft.) in a valley 11 km. (7 miles) to the southeast are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	6.2°C. (43.1°F.)
Mean January temperature	-4.3°C. (24.3°F.)
Mean July temperature	16.3°C. (61.4°F.)
Mean January minimum temperature	−9.9°C. (14.2°F.)
Mean July maximum temperature	27.8°C. (82.1°F.)
Average annual precipitation	490 mm. (19.3 in.)
June through August precipitation	76 mm. (3.0 in.)
Average annual snowfall	175 cm. (69.0 in.)

Precipitation is higher and temperatures lower on the natural area itself.

Soils on the area have not been mapped or described. Forest soils are developed from aerially deposited volcanic ash over buried soil profiles (Hall 1967). They resemble Gray Wooded soils and are not podzolized.

Grand fir - western larch - Douglas-fir forests	337 ha. (833 acres)
Wet and dry meadows	335 ha. (828 acres)
Grasslands	34 ha. (85 acres)
Western juniper - bunchgrass savannas	39 ha. (94 acres)
	32 ha. (80 acres)

The distribution of these types is shown in figure OD-2. Ponderosa pine stands are generally assignable to SAF forest cover type 237, Interior Ponderosa Pine (Society of American Foresters 1954), although fir reproduction is common, and to Küchler's (1964) Type 11 Western Ponderosa Forest. The mixed grand fir-western larch-Douglas-fir stands can be related to SAF type 213, Grand Fir - Larch - Douglas-Fir, and to Küchler's Type 14, Grand Fir - Douglas Fir Forest. The western juniper (*Juniperus occidentalis*) stands can be assigned to SAF type 238, Western Juniper, and to Küchler's Type 24, Juniper Steppe Woodland. The natural area is located within an *Abies grandis* Zone (Franklin and Dyrness 1969).

The forests dominated by old-growth ponderosa pine are also characterized by seedlings, saplings and sometimes poles of Douglas-fir, occasional western larch, and some grand fir. Ground vegetation is strongly dominated by pinegrass (*Calamagrostis rubescens*) (fig. OD-2). Other understory species are elk sedge (*Carex geyeri*), *Arnica cordifolia*, and *Lupinus* spp. Fire-scarred ponderosa pine are common. These stands have been classified as a mixed conifer/pinegrass community type by Hall (1967).

Grand fir - western larch - Douglas-fir stands are characteristic of north slopes. They vary in tree composition from nearly pure grand fir to a mixture of the three species. Ground vegetation is a moderately sparse stand of *Bromus vulgaris*, *Arnica cordifolia*, pinegrass, *Lupinus latifolius*, elk sedge, *Carex concinnoides*, *Hieracium albiflorum*, and *Pyrola* spp. Stands where larch is abundant contain fire-charred, dead, and downed

[...]communities occur on steep slopes and shallow soils (fig. OD-2). They are dominated by scattered western juniper with bitter cherry (*Prunus emarginata*), and Idaho fescue (*Festuca idahoensis*). Past livestock use and present game use of this highly palatable community have degraded the range to a point where it is considered in poor condition. Furthermore, the soils are shallow and recover very slowly following misuse.

The remaining grassland and meadow communities have not been extensively examined. One mountain meadow located in the southern half of the tract is dominated by *Poa pratensis* and *Bromus carinatus* with occasional *Veratrum californicum* and some *Cirsium vulgare*. Past livestock use has also altered vegetation in this meadow which might be considered to be in fair range condition.

Mule deer use the area as summer range. A complete list of mammals believed to utilize the natural area as residents or transients is provided in table OD-1.

HISTORY OF DISTURBANCE

Fire-scarred ponderosa pine indicate ground fires periodically burned the area prior to initiation of fire control programs about 1910. Hall (1967) has suggested that ponderosa pine/pinegrass communities constitute a fire climax which are shifting with fire control to grand fir and Douglas-fir climax. Dominance of fir reproduction in this plant community substantiates this hypothesis.

Some tree cutting, apparently for juniper fenceposts, occurred many years ago in the western juniper communities. A minor amount of timber was cut in connection with mining exploration work in the southwestern portion of the tract, the latest having occurred about 1966.

Domestic livestock grazed portions of the natural area between 1880 and 1963. Various segments of the tract were included in three grazing units — Nature Creek, Carrol Glade,

nds of sheep for four months of the umbers were gradually reduced, and 30 to 1960 one band continued to use . Sheep and cattle grazed the Carrol razing unit from 1880 to 1962 when acres of the natural area included in zing unit was fenced off. This use d of from 300 to 500 cattle from 1930 and one band of sheep, between July September 30 from 1940 to 1962. A iveway along the eastern edge of this unit had considerable influence on ern of grazing use. The Carrol Butte unit included about 400 acres of the area and, until 1960, had a pattern use comparable to the Nature Creek summarize the effects of grazing, ears to have affected the composition nunities with a high proportion of alatable species, such as the western and moist meadow types. It does not o have severely affected ground vege- the forest communities.

g claims in the southern half of the used disturbance of soil and vegeta- wever, these claims are not currently he area has recently been withdrawn neral entry.

RCH

search is known to have been con- within the natural area. However, mmunities similar to those found on ral area were described and charac- in Hall's (1967) extensive study of ion of the Blue Mountains.

atural area provides interesting op- ies to evaluate: (1) biomass produc- ffected by soils and topography under macroclimate; (2) natural forest suc- following control of ground fires; and nongame animal habitat in the of logging.

No special topographic or geologic maps are available for the natural area which are sufficiently detailed to be useful. Either the District Ranger (Big Summit Ranger District) or Forest Supervisor (Ochoco National Forest, Prineville, Oregon) can provide details on the most recent aerial photo coverage of the area.

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		coast mole
	Sorex obscurus	dusky shrew
	Sorex palustris	northern water shrew
	Sorex preblei	Preble shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis subulatus	small-footed myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Pipistrellus hesperus	western pipistrel
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Castor canadensis*	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Marmota flaviventris	yellow-bellied marmot
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus beldingi	Belding ground squirrel
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket gopher
	Zapus princeps	western jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx canadensis	Canadian lynx
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Taxidea taxus	badger
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

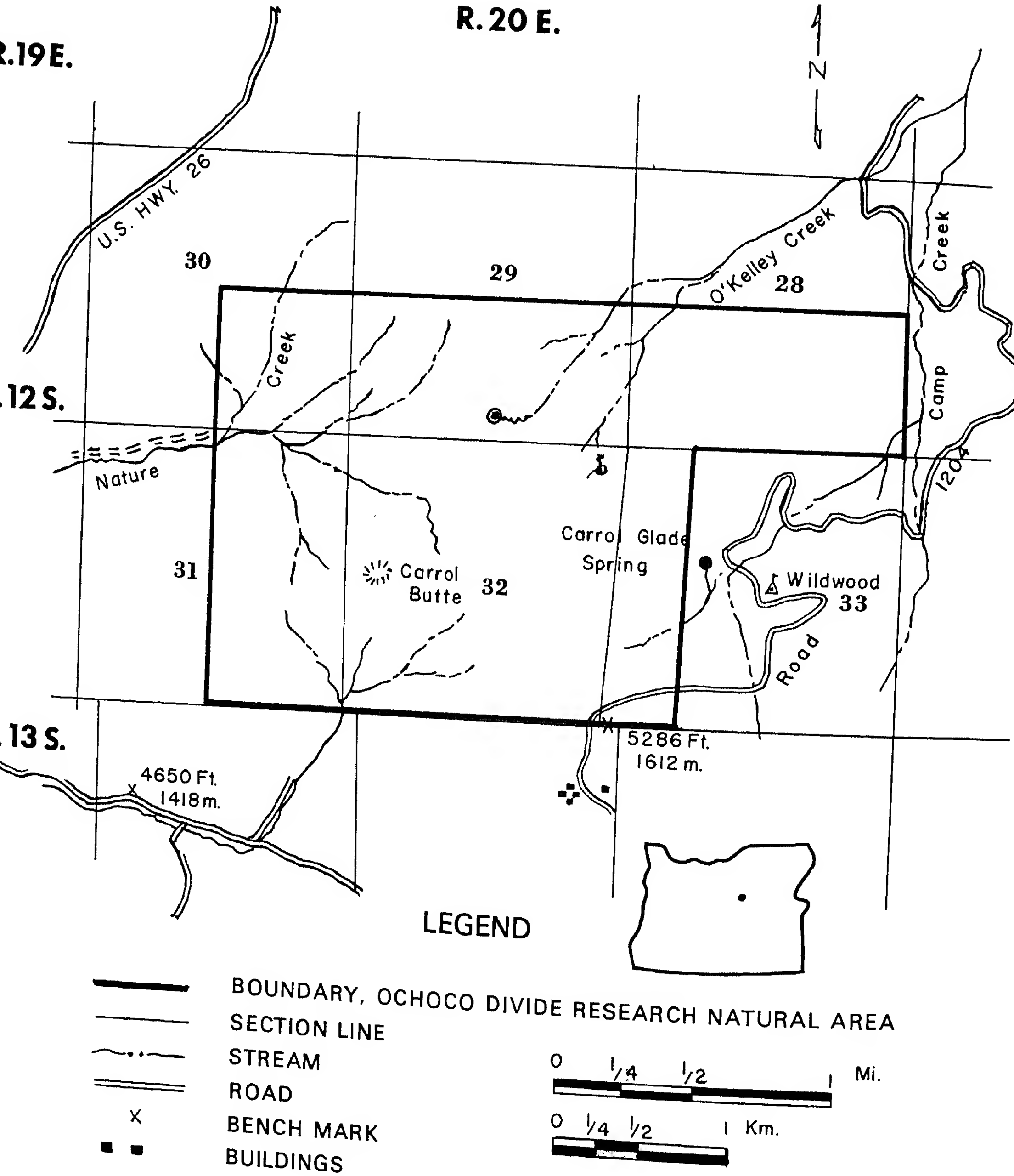
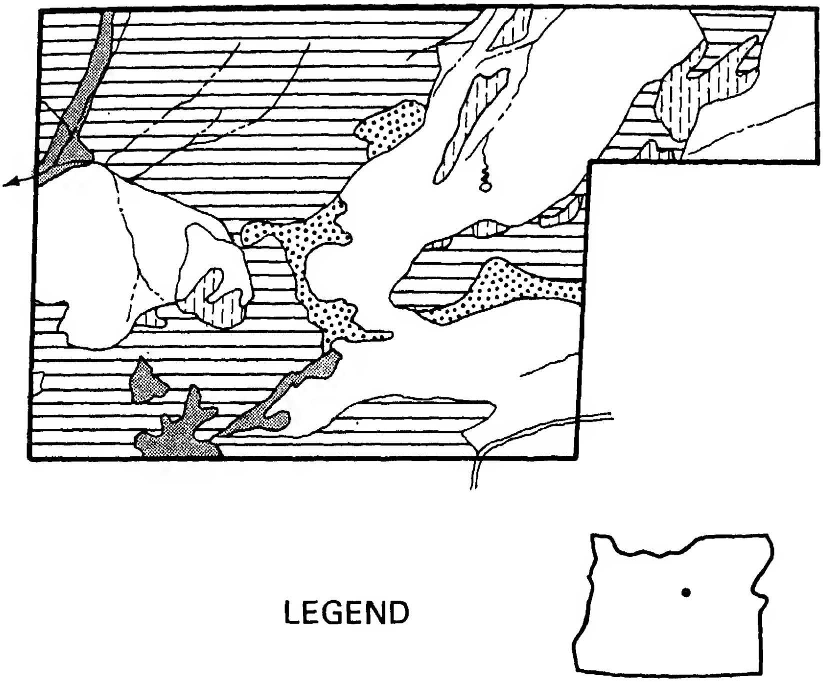


Figure OD-1.– Ochoco Divide Research Natural Area, Wheeler County, Oregon.



LEGEND

BOUNDARY, OCHOCO DIVIDE RESEARCH NATURAL AREA

STREAM

ROAD

0 1/4 1/2 1 Mi.

0 1/4 1/2 1 Km.

PONDEROSA PINE

GRAND FIR - WESTERN LARCH - DOUGLAS-FIR

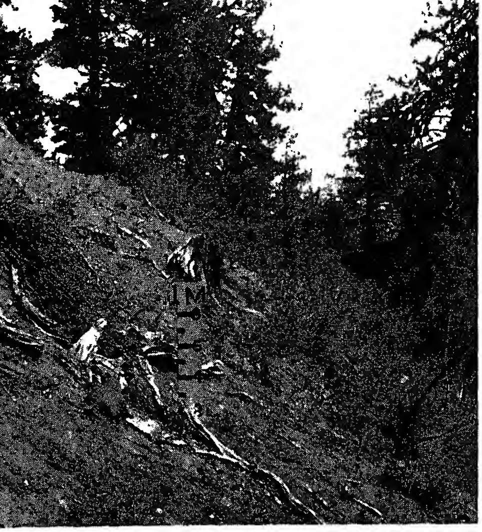
MEADOW

GRASSLAND

WESTERN JUNIPER

Figure OD-2.– **Vegetation types in the Ochoco Divide Research Natural Area.**

Figure OD-3.—Communities of the Ochoco Divide Research Natural Area. Upper left: Western juniper-bitter cherry/ Idaho fescue community on shallow soil; vegetation has deteriorated from livestock and game animal use. Upper right: Moist meadow dominated by *Poa pratensis* and *Bromus carinatus* with some *Verbascum* and *Cirsium*; a deteriorated community resulting from past livestock grazing. Lower left: Ponderosa pine-grand fir/pinegrass community; pine dominates the overstory while fir dominates reproductive size classes. Lower right: Grand fir/pinegrass community approaching climax condition with dying Douglas-fir and sedge.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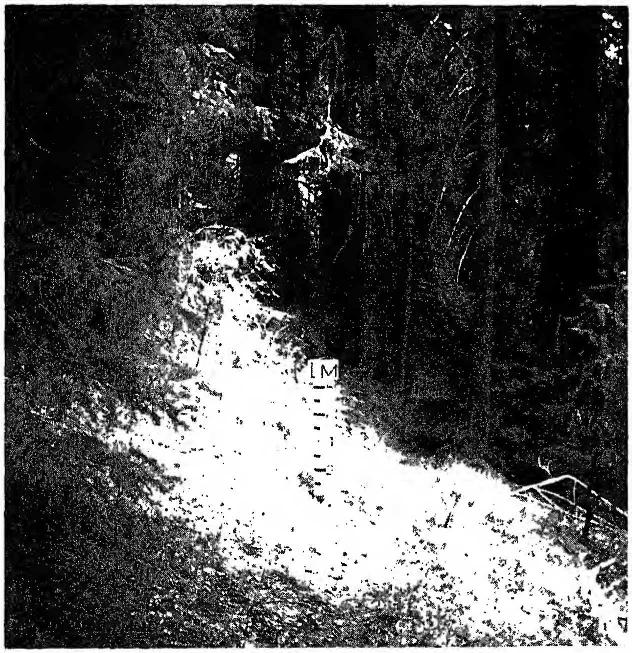
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OLALLIE RIDGE RESEARCH NATURAL AREA[1]

Subalpine mosaic of mountain meadows and true fir - mountain hemlock forest on some ridgetops in the western Cascades of Oregon.

The Olallie Ridge Research Natural Area was established on January 9, 1963, to provide examples of the mountain meadow and true fir (*Abies* spp.) - mountain hemlock (*Tsuga mertensiana*) communities found on high ridges in the western Cascades of Oregon. The 292-ha. (720-acre) tract is located in Lane County, Oregon, and is administered by the McKenzie Bridge Ranger District (McKenzie Bridge, Oregon), Willamette National Forest. The natural area is in two blocks each occupying the summit area of a ridgetop peak. The irregular boundaries (fig. OR-1) generally follow contour lines. The natural area is located in portions of sections 3, 4, 5, 8, 9, and 10, T. 17 S., R. 6 E., Willamette meridian, at 44°06′ N. latitude and 122°05′ W. longitude.

ACCESS AND ACCOMMODATIONS

The Olallie Ridge Research Natural Area can only be reached on foot. Several maintained trails penetrate or border portions of the tract. To reach the vicinity, turn south off of U.S. Highway 126 (McKenzie River Highway) onto the South Fork Road (Forest Road 1663). Follow this road and then the East Fork Road (Forest Road 1778) to the trail heads for either Forest Trails 3326 or 3312, located on the slopes below the natural area. These trails provide the quickest access and require from 1 to 2½ miles of foot travel to reach the natural area.

The nearest commercial accommodations are at Blue River or McKenzie Bridge along U.S. Highway 126. There are numerous improved public campgrounds along the McKenzie River and the South Fork of the McKenzie River, as well as a primitive campsite in the saddle between the two units of the natural area.

ENVIRONMENT

The Olallie Ridge Research Natural Area occupies summits of two peaks on a major, north-south trending ridge (fig. OR-2). Slopes are generally steep to moderate, and rock outcrops are common. There are no permanent streams or ponds within the natural area. Elevations range from about 1,341 to 1,686 m. (4,400 to 5,530 ft.) at the summit of O'Leary Mountain in the west unit and from 1,463 to 1,725 m. (4,800 to 5,660 ft.) on the summit of Horsepasture Mountain in the east unit.

The natural area lies within a geologically older (Eocene to Miocene) part of the Cascade Range known as the western Cascades (Peck et al. 1964; Williams 1957). The pyroxene andesites which dominate belong to the Sardine formation of Miocene age. Basalt, dacite, and various types of volcanic tuffs and breccias may also be present. Some data on lithology and petrography of the bedrock are found in Peck et al. (1964).

A cool, wet climate prevails. Summers are relatively dry; much of the heavy winter precipitation accumulates in snowpacks which probably attain maximum depths of 1 to 3 m. (3 to 9 ft.). The nearest climatic station (McKenzie Bridge) is at such a low elevation

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

cipitation slightly in excess of 2,000 mm. (80 in.).

Soils in the natural area have not been mapped or described. Forest soils are typically weakly developed Brown Podzolics developed at least partially in surficial layers of aeolian-deposited volcanic ash. Soils under the nonforested communities tend to be shallow and stony.

BIOTA

Approximately 118 ha. (290 acres) of the Olallie Ridge Research Natural Area are occupied by nonforested communities, including both meadow- and shrub-dominated types. The remaining area can be assigned to SAF forest cover types (Society of American Foresters 1954) as follows:

No.	*Name*	*Area*
205	Mountain Hemlock - Subalpine Fir	130 ha. (325 acres)
229	Pacific Douglas-Fir	33 ha. (82 acres)
211	White Fir	9 ha. (23 acres)

Küchler's (1964) types represented include Silver Fir - Douglas Fir Forest (3), Fir - Hemlock Forest (4), and possibly, Grand Fir - Douglas Fir Forest (14), and Alpine Meadows and Barren (52). The natural area is located within the *Abies amabilis* Zone of Franklin and Dyrness (1969).

The most outstanding features of the Olallie Ridge Natural Area are the nonforested communities which occupy a variety of habitats and support a rich flora. During a study of disjunction and endemism, Hickman (1968) examined the vascular plant flora of over 42 peaks; he found that Horsepasture Mountain is one of the most floristically diverse areas in the entire western Cascades. Hickman provides a checklist of species found on both Horsepasture and O'Leary Mountains; it includes at least 30 disjunct species of phytogeographic significance.

There are a variety of rock outcrop and meadow community types within the natural crop Ridge, and Vertical Outcrop. Snowbed communities are found on outcrops or steep, open slopes of north aspect where snow accumulations reach considerable depth in winter. Characteristic species include *Claytonia lanceolata*, *Luetkea pectinata*, *Orogenia fusiforma*, *Erythronium grandiflorum*, and *Mertensia bella*. The Rocky Melt Seep community occurs where snowmelt trickles over rock outcrops, particularly on south-facing slopes; such habitats are dry after midsummer. Typical species include *Dodecatheon jeffreyi*, *Lewisia triphylla*, *Mimulus brewerii*, *M. guttatus*, *Saxifraga occidentalis* var. *rufidula*, and *Gayophytum humile*.

The Wet Meadow community is one of the more extensive in the natural area. It is found on habitats with a constant moisture source and relatively deep soil. *Veratrum viride*, *Senecio triangularis*, and *Valeriana sitchensis* are characteristic dominants. Associated species include *Ribes bracteosum*, *Rubus spectabilis*, *Mitella breweri*, *Ligusticum grayi*, and *Hydrophyllum fendleri*, and *H. tenuipes*.

The Mesic Meadow community is also well represented. It is dominated by herbaceous perennials which have sufficient time to set seed in early summer before moisture supplies are exhausted. Typical dominants are *Rubus parviflorus*, *Pteridium aquilinum*, and *Rudbeckia occidentalis*. Associated species include *Erigeron aliceae*, *Lupinus latifolius*, *Ribes binominatum*, *R. viscosissimum*, *Polygonum phytolaccaefolium*, *Cirsium centaurea*, *Mertensia paniculata*, *Vicia americana* var. *truncata*, *Epilobium angustifolium*, and *Gayophytum humile*.

A third common meadow type is the Subalpine Xeric Meadow community which is found on habitats intermediate between the mesic meadows and the dry, rocky surrounding areas. Representative species include *Gilia aggregata*, *Collomia linearis*, *Gayophytum diffusum* var. *parviflorum*, *Orthocarpus imbricatus*, *Luina stricta*, *Polygonum minimum*, *P. douglasii*, *Navarretia divaricata*,

myrsinites, Amelanchier alnifolia var. semi-integrifolia, and Phacelia heterophylla. A closely associated community is confined to ridges of rapidly weathering rock (Fine Gravel Scree). Many of the species common in the xeric meadow community occur here, as well as *Lotus nevadensis*, *Sedum oregonense*, and *Sanicula graveolens*.

Outcrop Ridge communities are found where mass wasting of small fragments has produced outcroppings of small patches of parent rock which are barely exposed and eroded parallel to the general slope of the area. Many species root in the weathered cracks of the outcrops or pockets of finer material: *Delphinium menziesii* var. *pyramidale*, *Castilleja hispida*, *Penstemon procerus* var. *brachyanthus*, *Sedum stenopetalum*, *S. divergens*, *Eriophyllum lanatum*, *Arctostaphylos nevadensis*, *Haplopappus hallii*, *Silene douglasii*, *Comandra umbellata*, *Lomatium martindalei*, *Sanicula graveolens*, *Eriogonum umbellatum*, *E. compositum*, *Juniperus communis*, *Erigeron foliosus* var. *confinis*, *Arenaria capillaris* var. *americana*, *Erysimum asperum*, *Antennaria rosea*, *Phacelia heterophylla*, *Anaphalis margaritacea*, and *Penstemon cardwellii*. A few areas typifying the Vertical Outcrop community are present. Species adapted to these exposed environments include *Saxifraga bronchialis* var. *vespertina*, *Penstemon rupicola*, *Selaginella wallacei*, *Erigeron cascadensis*, *Polemonium pulcherrimum*, *Saxifraga caespitosa*, and *Heuchera micrantha*.

Tree species found within the natural area include mountain hemlock, Pacific silver fir (*Abies amabilis*), noble fir (*Abies procera*), western hemlock (*Tsuga heterophylla*), white fir (*Abies concolor*), subalpine fir (*Abies lasiocarpa*), and western white pine (*Pinus monticola*). All of the forests are relatively young in age (less than 130 years) and small in size; forest inventories of the area place all stands in either pole (maximum 28-cm. or 11-in. d.b.h.) or small sawtimber (maximum 53-cm. or 21-in. d.b.h.) size classes.

major climax species based on reproductive success in closed forest stands. The understory is typically poor in shrubs and relatively rich in herbaceous species. Common understory plants include *Achlys triphylla*, *Cornus canadensis*, *Clintonia uniflora*, *Pyrola secunda*, *Viola sempervirens*, *Rubus lasiococcus*, *Vaccinium membranaceum*, *Osmorhiza chilensis*, and *Arnica* sp.

On the dry, south-exposed slopes, forests are more typically dominated by Douglas-fir or white fir or both; Pacific silver fir often dominates the tree reproduction in these stands. Typical understory plant species include *Symphoricarpos* spp., *Chimaphila umbellata*, vine maple (*Acer circinatum*), *Pyrola picta*, *Rosa gymnocarpa*, *Pteridium aquilinum*, *Achlys triphylla*, *Smilacina sessilifolia*, and *Vaccinium membranaceum*.

In addition to meadows and forests there are significant areas occupied by shrub-dominated communities. These are typically found on wet sites adjacent to meadows or forests, on steep, north-facing slopes, and on talus associated with rock outcrops. Sitka alder (*Alnus sinuata*) is the common dominant on wetter substrates and north slopes where it forms dense thickets. Hickman (1968) considered this community to be a phase of his Wet Meadow type; they certainly are frequently associated with wet meadows and actually intergrade with them in some situations where the alder stems are more scattered. Deep winter snow accumulations and extensive snow creep cause strong bowing of the 3 to 5 m. (10 to 16 ft.) tall stems. In a nearby area the occurrence of these stands has been related to high soil water tables due to a nearly impervious subsoil[2], but in other regions they are associated with recurrent avalanches. Vine maple dominates the shrub communities on drier sites, and both species occasionally occur as codominants in mixed

[2] Unpublished soil survey data from the H. J. Andrews Experimental Forest on file at USDA Forest Service, Forestry Sciences Laboratory, Corvallis, Oregon.

early summer and fall range of deer (*Odocoileus hemionus columbianus*) and Roosevelt elk (*Cervus canadensis roosevelti*). Other mammals believed to occur within the natural area as residents or transients are listed in table OR-1.

HISTORY OF DISTURBANCE

The dominance of 130-year-old stands indicates the area has been subject to at least occasional fires, the last major one occurring in the mid-1800's. There are extensive areas of dead subalpine fir in and around the wet meadows which are probably the result of infestations of balsam woolly aphid over the last decade (Franklin and Mitchell 1967).

The natural area was intensively used as a sheep range until about the middle of the 1930's. There is still evidence of sheep camps around some grassy openings. Meadow composition has undoubtedly been strongly influenced by overgrazing of sheep.

RESEARCH

Extensive observations of the flora and plant communities of O'Leary and Horsepasture Mountains were made during Hickman's (1968) study of disjunction and endemism in the western Cascades of Oregon. His findings of floral diversity and community types have already been highlighted; for more complete information, see his original paper

provides an unusual opportunity for studying subalpine meadow-forest mosaics. Possible studies include variation in community composition, structure, productivity, and succession in relation to environmental factors. It is also an important refugium for disjunct populations of numerous plant species.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area are: *Topography* — 15′ McKenzie Bridge, Oregon quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1955; and *geology* — *Reconnaissance Geologic Map and Sections of the Western Cascade Range, Oregon, North of Latitude 43° N.*, scale 1:250,000 (Peck et al. 1964), *Geologic Map of the Central Park of the High Cascade Range, Oregon* (Williams 1957), and *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). Either the District Ranger (McKenzie Bridge Ranger District) or Forest Supervisor (Willamette National Forest, Eugene, Oregon) can provide details on the most recent aerial photo coverage and forest type maps for the area.

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[3] Research by Dr. J. M. Trappe, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

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		shrew mole
	Scapanus orarius	coast mole
	Sorex bendirii	marsh shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
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	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
	Ochotona princeps	pika
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	Arborimus longicaudus	red tree vole
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus richardsoni	Richardson vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Tamiasciurus douglasi	chickaree
	Thomomys mazama	Mazama pocket gopher
	Zapus trinotatus	Pacific jumping mouse
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	Canis lupus	wolf
	Felis concolor	mountain lion or cougar
	Gulo luscus	wolverine
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

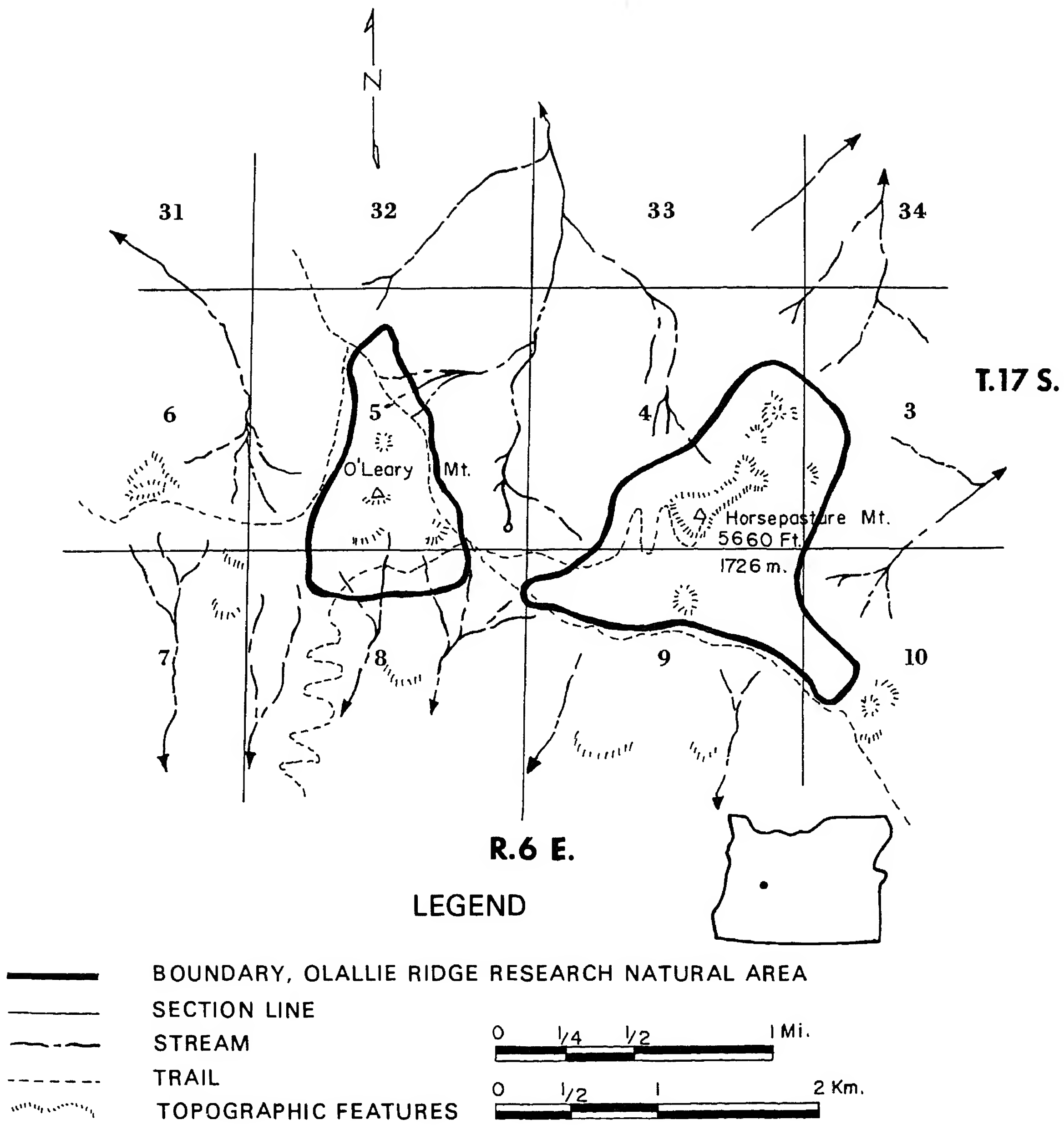

Figure OR-1.– Olallie Ridge Research Natural Area, Lane County, Oregon.

Figure OR-2.—Natural features of Olallie Ridge Research Natural Area. Upper left: Stand of noble fir, Pacific silver fir, and mountain hemlock typical of closed forest areas on cool, northerly exposed slopes. Upper right: Stand of Douglas-fir, grand fir, and western white pine typical of closed forest areas on drier, southerly aspects. Center left: Grassy opening typical of those found interspersed through forested areas on dry south slopes. Center right: Southeastern slopes of O'Leary Mountain; note the forest-meadow mosaic typical of southerly exposures and open nature of the true fir stand on the northeast slope. Bottom: Northwestern slopes of Horsepasture Mountain showing true fir-mountain hemlock stands and a wet meadow area surrounding a community of Sitka alder; note the numerous subalpine firs near the summit of the mountain which have been killed by insects.





PATAHA BUNCHGRASS RESEARCH NATURAL AREA[1]

A grassland-forest mosaic of bluebunch wheatgrass and Douglas-fir communities located at the northern edge of the Blue Mountains in southeast Washington.

The Pataha Bunchgrass Research Natural rea was established in December 1968 as an xample of mountain bunchgrass vegetation ccurring at the transition from coniferous rest to steppe vegetation. The 20.7-ha. (51-cre) tract is located in Garfield County, Vashington, and is administered by the Pomroy Ranger District (Pomeroy, Washington), matilla National Forest. It is located in the W ¼ of section 1, T. 9 N., R. 42 E., Willamette eridian, at 46°17′ N. latitude and 117°30′ W. ngitude.

CCESS AND CCOMMODATIONS

Access is via State Highway 128 from Pomroy to the junction with Forest Road No. N-94 ron Spring Road), a distance of 22 km. (14 iles). Road N-94 passes along the eastern de of the tract (fig. PB-1). Access during mmer is good but becomes difficult during e winter. Public accommodations are availle in Pomeroy or about 9 km. (6 miles) uth of the tract at Big Springs Forest Camp.

NVIRONMENT

The Pataha Bunchgrass Research Natural rea has a mean elevation of 1,372 m. (4,500 ft.) with a total variation of about 60 m. (200 ft.). Topography varies from flat to steep where it forms an upper part of the slope adjacent to Pataha Creek. The tract is located on the edge of a dissected plateau straddling the transition from the flat plateau top to steep canyon slopes. Columbia River basalts underlie the entire area. They have been uplifted and severely dissected by natural erosion.

A modified maritime climate prevails. Most precipitation occurs as snow during the cool, cloudy winter. Summers are warm, generally low in precipitation and largely cloudless. One to 3 months of drought are common. Climatic data from Peola, located 3 km. (2 miles) to the north are as follows (U.S. Weather Bureau 1956):

Mean January temperature	7°C.	(20°F.)
Mean July temperature	20°C.	(65°F.)
Average annual precipitation	584 mm.	(23.12 in.)
June through August precipitation	100 mm.	(3.94 in.)
Average annual snowfall	229 cm.	(90.00 in.)

Soils on the area have not been mapped recently; the Waha, Underwood, and Helmer soil series are possibly present (Washington Agricultural Experiment Stations 1954). Soil descriptions obtained at the time of the guidebook field examination are as follows:

(1) A shallow Lithosol with little profile development located on a plateau top of 0- to 5-percent slope and occupied by a bluebunch wheatgrass (*Agropyron spicatum*)-Idaho fescue (*Festuca idahoensis*) community:

A	0 to 15 cm.	Very dark brown (10 YR 2/2 moist, 2/3 dry) silt loam; slightly plastic, slightly sticky, with moderate, very fine subangular blocky structure; pH 6.7.

[1] Description prepared by Dr. F.C. Hall, U.S. Dertment of Agriculture, Forest Service, Region 6, rtland, Oregon.

Bedrock	25 cm. +	Poorly cracked; evidence of restricted moisture drainage.

(2) A very shallow Lithosol with little profile development located on a 20-percent slope at the transition from plateau top to steep sideslope and occupied by a Sandberg's bluegrass (*Poa sandbergii*)-bluebunch wheatgrass community:

A	0 to 10 cm.	Dark brown (7.5 YR 2/2 moist, 3/2 dry) gravelly silt loam; slightly plastic, slightly sticky with weak, very fine granular structure; pH 6.8; 30- to 40-percent gravel.
B	10 to 20 cm.	Dark brown (7.5 YR 2/2 wet, 3/2 dry) very stony silt loam; slightly plastic, slightly sticky with weak, very fine granular structure; pH 6.8; 90- to 95-percent stone.
Bedrock	20 cm. +	Poorly cracked; evidence of restricted drainage.

(3) Profile with moderate development on steep (60- to 80-percent) southerly slope occupied by bluebunch wheatgrass community:

A	0 to 20 cm.	Dark brown (7.5 YR 2/2 moist, 3/3 dry) gravelly loam; slightly plastic, non-sticky with weak, very fine granular structure; pH 6.8; 30- to 40-percent gravel.
B	20 to 50 cm.	Dark brown (7.5 YR 2/2 moist, 3/2 dry) gravelly silt loam; plastic and slightly sticky with moderate, fine subangular blocky structure; pH 6.9; finely vesicular when dry; 20- to 40-percent stone, 20- to 30-percent gravel.
C	50 to 65 cm.	Dark brown (7.5 YR 3/2 moist, 4/4 dry) gravelly silt loam; plastic and slightly sticky with moderate, fine subangular blocky structure; pH 6.8; vesicular when dry; 20- to 40-percent stone, 20- to 30-percent gravel.
Bedrock	65 cm. +	Poorly cracked; evidence of clay depositions.

BIOTA

Estimated areas by community types are:

Name	Area
Agropyron spicatum/Poa sandbergii	13 ha. (33 acres)
Pseudotsuga menziesii-Abies grandis/Vaccinium membranaceum	7 ha. (18 acres)

The forest stands probably are assignable to SAF forest cover Type 210, Interior Douglas-Fir (Society of American Foresters 1954), and Küchler's (1964) Type 14, Grand Fir-Douglas Fir Forest. The grasslands best fit Küchler's (1964) Type 51, Wheatgrass-Bluegrass. The area would fall within a ponderosa pine (*Pinus ponderosa*) Zone if it were present in this area. However, most vegetation in the Blue Mountains is strongly affected by topography and soils, and this tract is an excellent example. South slopes represent an upper elevational extension of the bunchgrass steppe, and north slopes represent a lower elevational extension of fir forest.

Bluebunch wheatgrass dominates the bunchgrass stands (fig. PB-2). The relative position of wheatgrass in the plant community varies with soils and topography. On the plateau, it tends to dominate in both density and volume with Idaho fescue and Sandberg's bluegrass as constant and important associates. *Eriogonum heracleoides*, *Lupinus sericeus*, *Erigeron eatoni*, *E. bloomeri*, *Balsamorhiza serrata*, and *Achillea millefolium* are commonly present. On the transition from plateau to steep slopes, bluebunch wheatgrass codominates with Sandberg's bluegrass while *L. sericeus*, *E. eatoni*, *E. bloomeri*, and *B. serrata* are present. Bluebunch wheatgrass again dominates in both density and volume on steep south slopes. Sandberg's bluegrass and Idaho fescue are clearly subordinant in density and volume. Associated species are different, including *Berberis*

he natural area contains a small ... grassland on rather deep soil, which Idaho fescue clearly dominates. Associated species are *Poa pratensis* and *Bromus tectorum*.

Most of the seven forested hectares (18 acres) represent seral stages of the *Abies grandis/Vaccinium membranaceum* association (Hall 1967). Douglas-fir (*Pseudotsuga menziesii*) dominates the tree overstory with occasional ponderosa pine (fig. PB-2). Reproduction is largely grand fir (*Abies grandis*). Ground vegetation is dominated by *Vaccinium membranaceum* and pinegrass (*Calamagrostis rubescens*) associated with species such as elk sedge (*Carex geyeri*), *Hieracium albiflorum*, *Lupinus latifolius*, and several well-developed colonies of the orchid *Cypripedium montanum*.

A *Pinus ponderosa/Calamagrostis rubescens* community forms an interrupted transitional band between grassland and Douglas-fir forest (fig. PB-2). Ponderosa pine clearly dominates and exhibits an open growth form with living branches extending within 3 m. (10 ft.) of the ground. Pinegrass strongly dominates ground vegetation, with other species such as *Spirea lucida*, elk sedge, *Lupinus latifolius*, and *Achillea millefolium* as common associates. Reproduction of Douglas-fir and grand fir is sporadic despite an abundant, adjacent seed source, suggesting this pine community is reasonably stable successionally.

Mammals believed to utilize the tract as residents or transients are listed in table PB-. Elk (*Cervus canadensis*) use the area as winter range and occasionally as spring or fall range during deeper snowfall. In general, they tend to move off the tract sufficiently early in the spring that grazing damage to grasses is prevented. Most forbs seem unpalatable to elk in this area.

HISTORY OF DISTURBANCE

Fire scars on ponderosa pine indicate periodic ground fires prior to initiation of fire control programs in 1910. Lack of dominant ... all portions of the forest have burned at some time. Sufficient grass volume is present on the grassland to carry a fire so one should assume it has been burned. Fire scars suggest the last fire was about 1890.

Domestic livestock grazed the tract to some extent between 1890 and 1945, when livestock numbers in the allotment were reduced. Topography and lack of water have precluded extensive or heavy livestock use. The area has probably not been significantly altered by grazing.

RESEARCH

Vegetation and soil descriptions and environmental notes for the grasslands on the plateau top, a steep south slope, and the transitional area are available.[2] Vegetation analysis utilized the "three step method" in which a 1.9-cm. or ¾-in. loop is placed 100 times along each of two transects and on which vegetation or ground cover notes are made. Reconnaissance notes are also available for the forest vegetation.

The natural area provides interesting research opportunities on (1) effects of game use on bunchgrass vegetation; (2) factors responsible for the mosaic pattern of forest and nonforest communities; (3) variation in bunchgrass communities from flat plateau to steep slopes; and (4) biomass production as affected by soils and topography under a single macroclimate.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic maps are available for the natural area which are sufficiently detailed to be useful. Either the District Ranger (Pomeroy Ranger District) or Forest Supervisor (Umatilla National Forest,

[2] Research by Dr. F.C. Hall, Division of Range and Wildlife, U.S. Forest Service, P.O. Box 3623, Portland, Oregon.

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Washington, D.C.

U.S. Weather Bureau
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Washington Agricultural Experiment Stations
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Insectivora	*Scapanus orarius*	coast mole
	Sorex merriami	Merriam shrew
	Sorex palustris	northern water shrew
	Sorex preblei	Preble shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis subulatus	small-footed myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Pipistrellus hesperus	western pipistrel
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
	Lepus californicus	black-tailed jack rabbit
	Sylvilagus nuttalli	mountain cottontail
Rodentia	*Clethrionomys gapperi*	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus columbianus	Columbian ground squirrel
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus hudsonicus	red squirrel
	Thomomys talpoides	northern pocket gopher
	Zapus princeps	western jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx canadensis	Canadian lynx
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Taxidea taxus	badger
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

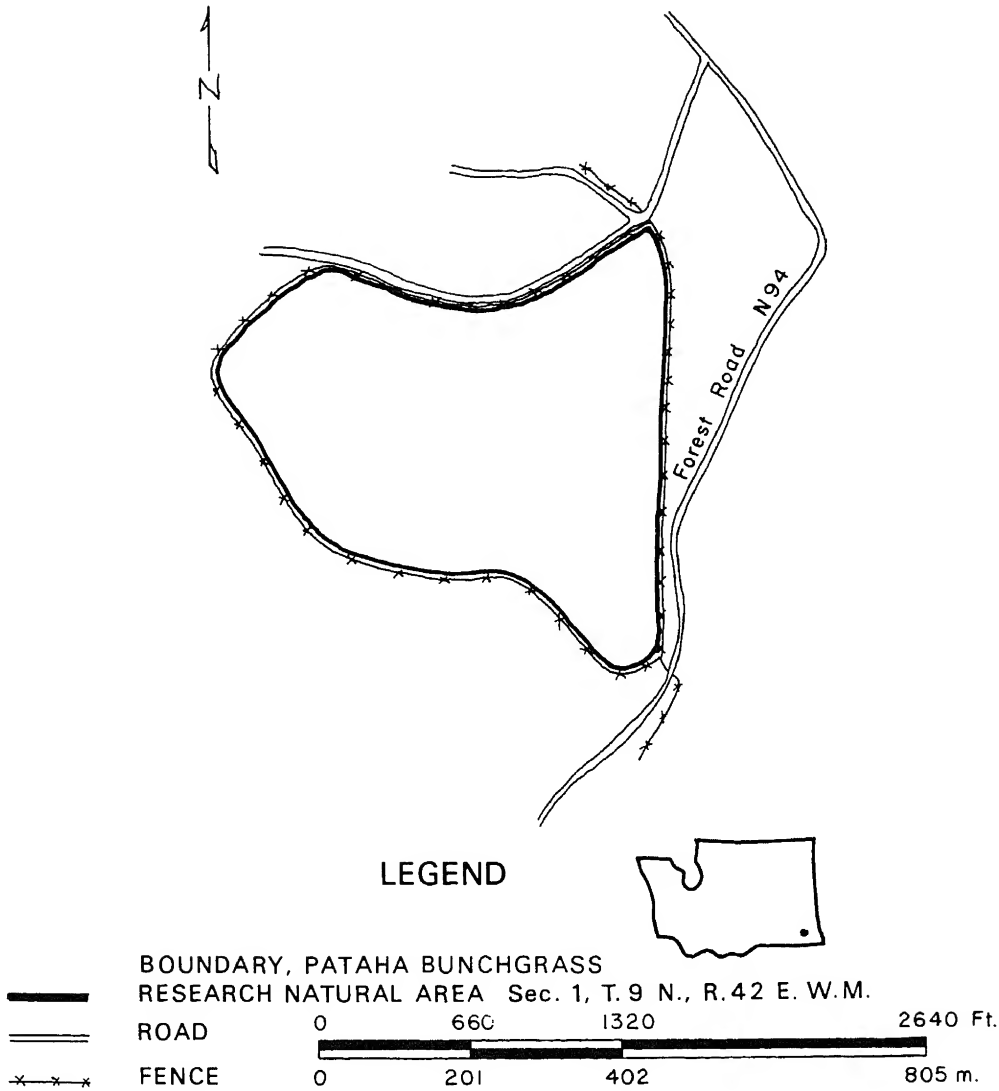
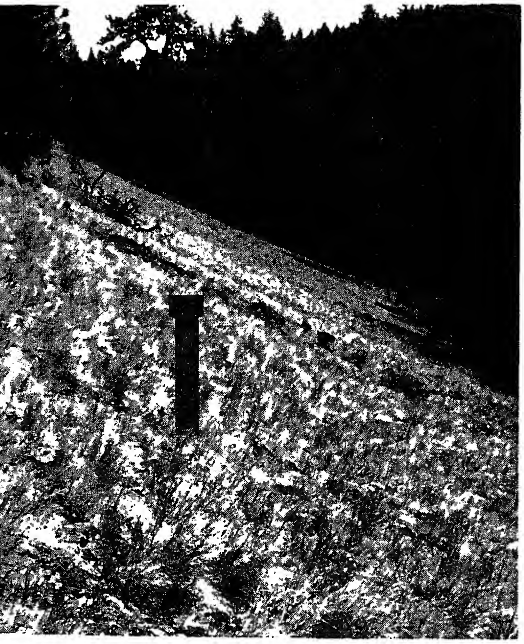


Figure PB-1.– **Pataha Bunchgrass Research Natural Area, Garfield County, Washington.**

Figure PB-2.—Natural features of Pataha Bunchgrass Research Natural Area. Upper left: Flat plateau top with bluebunch wheatgrass-Sandberg's bluegrass community on soils 3 to 4 dm. (12 to 18 in.) deep. Upper right: Topographic break from plateau to steep slopes occupied by community of Sandberg's bluegrass and low-density bluebunch wheatgrass growing on shallow soil 2 to 3 dm. (8 to 12 in.) deep. Lower left: Steep (60-percent), south slope occupied by bluebunch wheatgrass community with scattered Sandberg's bluegrass growing on deep, colluvial soil. Lower right: North-slope forest stand on *Abies grandis/Vaccinium membranaceum* habitat type with Douglas-fir, occasional ponderosa pine, and pinegrass.




LM

PERSIA M. ROBINSON RESEARCH NATURAL AREA[1]

Ponderosa pine and Douglas-fir forest characteristic of lower elevations on the east slope of the Oregon Cascade Range.

The Persia M. Robinson Research Natural
rea was established in March 1948. It ex-
nplifies the ponderosa pine (*Pinus ponder-
sa*) and mixed pine-Douglas-fir (*Pseudotsuga
enziesii*) typifying the lower forest zone
n the east slope of the northern Oregon's
ascade Mountains. The 118-ha. (540-acre)
act is located in Wasco County, Oregon, and
administered by Bear Springs Ranger
istrict (Route 1, Box 65, Maupin, Oregon),
lount Hood National Forest. The essentially
quare area is located in sections 10 and 11,
. 6 S., R. 10 E., Willamette meridian, at
5°05′ N. latitude, and 121°30′ W. longitude
ig. PE-1).

CCESS AND CCOMMODATIONS

The natural area is located along U.S.
ighway 26 about 35 km. (22 miles) southeast
Government Camp and 40 km. (25 miles)
orthwest of Warm Springs. The highway
rms the eastern boundary of the tract.
ccess is good during both the summer and
inter since snow is removed from the high-
ay. Public accommodations are available
Government Camp or Warm Springs; there
e several improved forest camps in the
cinity of the natural area.

[1] Description prepared by Dr. F. C. Hall, U.S.
epartment of Agriculture, Forest Service, Region
Portland, Oregon.

ENVIRONMENT

The Persia M. Robinson Research Natural Area varies from approximately 850 to 950 m. (2,800 to 3,100 ft.) in elevation. Topography is undulating to rolling and is typical of lower foothills on the east slope of the Cascade Range.

The bedrock is composed of basalts and andesites, with andesitic flows probably predominant (Peck 1961).

A modified continental climate prevails. Most precipitation occurs as snow during the cool, cloudy winter. Summers are warm, generally low in precipitation and largely cloudless. One to 3 months of drought are common. Unpublished climatic data collected at Bear Springs Ranger Station located 5 km. (3 miles) north of the natural area are on file there. No relevant published data are available. Isohyetal maps suggest around 900 mm. (35 in.) of annual precipitation.

Soils in the area have not been mapped. Cursory examinations suggest aerially deposited pumicite is commonly mixed with residual materials.

BIOTA

Estimated areas by forest communities are:

Name	*Area*
Pinus ponderosa-Pseudotsuga menziesii/ Acer circinatum/Calamagrostis rubescens	107 ha. (265 acres)
Pseudotsuga menziesii-Abies grandis/ Acer circinatum	111 ha. (275 acres)

The ponderosa pine-Douglas-fir stands can be assigned to SAF forest cover type 214, Ponderosa Pine-Larch-Douglas-Fir (Society of American Foresters 1954) and Küchler's Type 12, Douglas Fir Forest. Douglas Fir-grand fir (*Abies grandis*) stands probably belong to SAF type 213, Grand Fir-Larch-Douglas-Fir and Küchler's Type 14, Grand

Stand composition in this tract seems more closely related to ground fire history than to site variability (fig. PE-2). Stands currently dominated or codominated by ponderosa pine have minimal old-growth Douglas-fir. However, Douglas-fir seedlings and saplings are abundant and clearly dominate the smaller size classes; some poles are also present. Incense-cedar (*Libocedrus decurrens*) also occur occasionally. The understory in these communities is dominated by vine maple (*Acer circinatum*), *Symphoricarpos albus*, and *Ceanothus velutinus* in the shrub layer and pinegrass (*Calamagrostis rubescens*) and *Pteridium aquilinum* in the herb layer. Most of the *Ceanothus* is dead.

Douglas-fir-grand fir stands include occasional old-growth ponderosa pine in the overstory. Douglas-fir dominates the overstory and grand fir the seedling, sapling, and pole size classes. Western larch (*Larix occidentalis*) is sometimes a common stand constituent. Where crown cover of trees is dense, ground vegetation is minimal and typically composed of vine maple and pinegrass with occasional *Symphoricarpos*, *Pteridium*, and some forbs.

A list of mammals believed to utilize the natural area as residents or transients is provided in table PE-1.

HISTORY OF DISTURBANCE

Fire scarred ponderosa pine and western larch record periodic ground fires which some time.

Domestic livestock occasionally grazed the tract between 1890 and 1945 when livestock were removed from the general area. Cattle still drift into the area occasionally from adjacent lands. However, the natural area does not appear to have been significantly affected by grazing.

RESEARCH

No research is known on the tract. The natural area provides interesting opportunities to study: (1) forest succession in the absence of ground fires; (2) biomass productivity in undisturbed forest stands; and (3) stand structure and development in natural stands. Comparisons are possible with conditions on logged areas on adjacent National Forest and Indian Reservation land.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Mount Wilson, Oregon quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1956; and *geology* — *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). Either the District Ranger (Bear Springs Ranger District) or Forest Supervisor (Mount Hood National Forest) can provide details on the most recent aerial photo coverage of the area.

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ïchler, A. W.
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Society of American Foresters
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	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
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	Ochotona princeps	pika
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	Arborimus longicaudus	red tree vole
	Castor canadensis	beaver
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
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	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys mazama	Mazama pocket gopher
	Zapus trinotatus	Pacific jumping mouse
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	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer

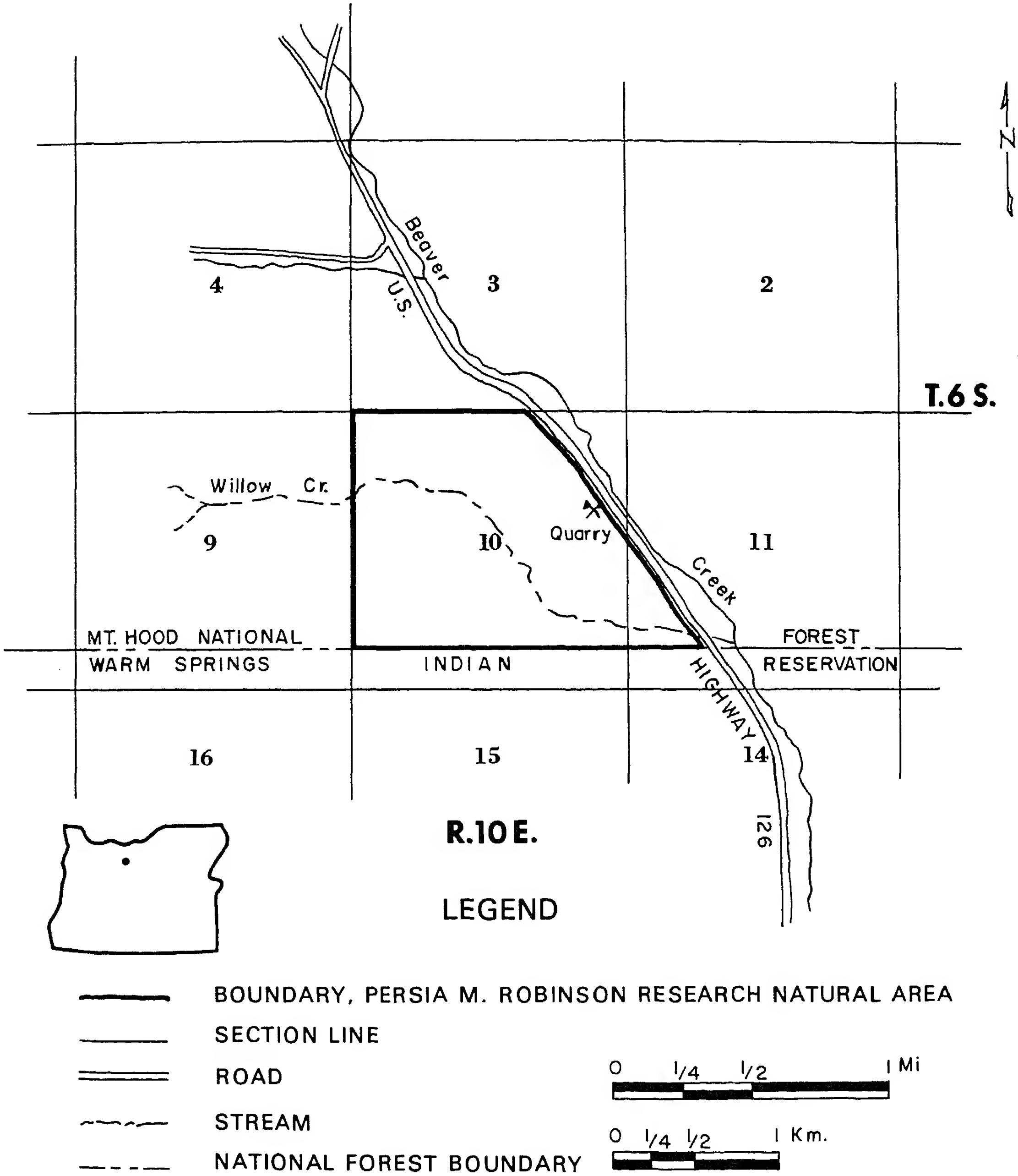

Figure PE-1.—**Persia M. Robinson Research Natural Area, Wasco County, Oregon.**

Figure PE-2.—Natural features of Persia M. Robinson Research Natural Area. Top: General view of forests along U.S. Highway 26 with ponderosa pine overstory and understory of Douglas-fir reproduction. Lower left: South slope community of ponderosa pine and some Douglas-fir with understory of vine maple, dead *Ceanothus velutinus, Pteridium aquilinum,* and pinegrass. Lower right: Typical ponderosa pine community found on east and north slopes with Douglas-fir reproduction and ground cover of vine maple, *Symphoricarpos albus,* pinegrass, and forbs.

PIGEON BUTTE RESEARCH NATURAL AREA[1]

Oregon white oak stands growing on a low hill in Oregon's Willamette Valley.

'igeon Butte Research Natural Area was .blished December 27, 1966, to exemplify gon white oak (*Quercus garryana*) stands cal of those found in western Oregon's lamette Valley. The 28-ha. (70-acre) tract ocated in Benton County, Oregon, and is inistered by the William L. Finley Na- al Wildlife Refuge (Route 2, Box 208, vallis, Oregon), Bureau of Sport Fisheries Wildlife. The natural area is located in ion 32, T. 13 S., R. 5 W., Willamette idian, at 44°24′ N. latitude and 123°19′ .ongitude.

CESS AND COMMODATIONS

he natural area is found in the William L. ley National Wildlife Refuge which is ted about 16 km. (10 miles) south of vallis, a short distance off U.S. Highway ' (fig. PI-1). The natural area is located ıt 0.2 km. (0.5 mile) from a graveled all- ther road. Several dirt fire patrol roads roach the tract. Visitors should inquire he Refuge headquarters about the best e of approach. Numerous commercial mmodations are available in Corvallis; e are no campgrounds within the refuge.

escription prepared by Dr. J. F. Franklin, Department of Agriculture, Forest Service, c Northwest Forest and Range Experiment on, Forestry Sciences Laboratory, Corvallis, on.

ENVIRONMENT

The Pigeon Butte Research Natural Area occupies the northerly slopes of Pigeon Butte, a relatively isolated hill rising 76 m. (250 ft.) from the floor of the valley. All of the tract is located on gentle to moderate slopes. There are no streams or springs located within the natural area. Elevations range from about 91 to 168 m. (300 to 550 ft.).

The natural area is located on a hill of light gray to yellowish brown arkosic micaceous sandstone surrounded by Willamette Valley alluvium (Vokes et al. 1954). This material belongs to the Spencer formation of upper Eocene Age. A narrow dike or sill-like body of intrusive igneous rocks (probably basalt or gabbro) runs along the southern boundary of the natural area from east to west.

The natural area is located in western Oregon, an area of mild, moist climate. However, it is within the Willamette Valley, which is located between the Coast and Cascade Ranges and is, therefore, subject to the somewhat warmer and drier climate typical of interior western Oregon valleys. The summer dry period is especially pronounced. Representative climatic data from the Corvallis weather station, which is about 16 km. (10 miles) north, are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	11.6°C.	(53.0°F.)
Mean January temperature	4.1°C.	(39.4°F.)
Mean July temperature	19.2°C.	(66.6°F.)
Mean January minimum temperature	0.6°C.	(33.1°F.)
Mean July maximum temperature	27.1°C.	(80.8°F.)
Average annual precipitation	957 mm.	(37.67 in.)
June through August precipitation	49 mm.	(1.93 in.)

The soils within the natural area have been mapped as the Dixonville silty clay loam. This soil series has been classified as a Brunizem and Pachic Ultic Argixeroll

dark brown A1 from 0 to 13 cm.; very dark gray brown A3 from 13 to 32 cm.; and very dark brown, clayey B2t from 32 to 66 cm.

BIOTA

Estimated areas by vegetation types are:

Name	*Area*
Oregon white oak closed forest	19 ha. (46 acres)
Oregon white oak savanna	7 ha. (18 acres)
Grassland	2 ha. (5 acres)

The areas of forest and savanna fit the Society of American Foresters (1954) cover type 233, Oregon White Oak, and Küchler's (1964) Type 26, Oregon Oakwoods. The natural area lies within the Interior Valley (*Pinus-Quercus-Pseudotsuga*) Zone of Franklin and Dyrness (1969).

The major tree species in the natural area is Oregon white oak (fig. PI-2). Anderson (1970) indicates that about 82 percent of the canopy cover is composed of this species. Dominant oaks typically range up to 60-cm. (24-in.) d.b.h. with occasional specimens exceeding 90-cm. (36-in.) d.b.h. Heights of dominants are generally from 18 to 21 m. (60 to 70 ft.). Other tree species present include bigleaf maple (*Acer macrophyllum*) and Pacific dogwood (*Cornus nuttallii*). Grand fir (*Abies grandis*) and Douglas-fir (*Pseudotsuga menziesii*) are extremely uncommon.

The closed canopy oak forests found on the natural area are probably of relatively recent origin. Habeck (1961, 1962) documents a major conversion of prairie and oak savanna to closed oak forest since settlement of the Willamette Valley. Fire control activities instituted by the settlers are believed responsible for this major successional change. Thilenius' (1964, 1968) detailed analyses confirm the fact that most Oregon white oak stands originated after 1850. Typically they are composed of scattered large trees of open-grown form and averaging 237 years old made up of smaller oaks of forest-grown form.

Successional relationships within closed-canopy Oregon white oak stands are not clear (Franklin and Dyrness 1969). In the natural area bigleaf maple is the most conspicuous tree species in the reproductive size classes. Seedlings and saplings of oak are rarely found in closed canopy stands. Douglas-fir and grand fir, both of which have been suggested as climax species, are uncommon.

Most of the closed forest stands have relatively well-developed shrub and herb layers. Anderson (1970) describes a dense shrub layer averaging about 3,500 plants per ha. (1,400 per acre). *Corylus cornuta* var. *californica*, *Amelanchier alnifolia*, *Crataegus douglasii*, and *Osmaronia cerasiformis* are the most common tall shrubs. *Rhus diversiloba* is one of the most common low shrubs, and it is also conspicuous in a liana growth form. Thilenius (1964) has hypothesized that *Rhus diversiloba* is favored by grazing of oak woodlands because of interconnections between shrub and liana growth forms and its less palatable status. Other common low shrubs are *Rubus ursinus*, *Symphoricarpos albus*, and *Rosa nutkana*. Typical herbs are *Polystichum munitum*, *Pteridium aquilinum*, *Galium triflorum*, *Bromus laevipes*, *Montia sibirica*, *Hypericum perforatum*, *Lomatium utriculatum*, *Osmorhiza nuda*, *Satureia douglasii*, *Vicia americana*, and *Tellima grandiflora*. Most of the closed forest stands seem to best fit the *Quercus garryana/Corylus cornuta/Polystichum munitum* community described by Thilenius (1964).

The savannas of Oregon white oak have not been carefully examined. The understory is typified by an abundance of grasses and forbs including many introduced species. *Rhus diversiloba* is also conspicuous in parts of the savanna.

The grasslands are located mostly on the upper west and northwest exposed slopes of Pigeon Butte (fig. PI-1). Communities are

...ced species including all of the annual
dominants. The grassland areas appear natural (as opposed to tracts created ...lers or latter-day farmers by clearing ...ing). The composition has been strong-...uenced by heavy grazing of domestic ...and sheep. Successional status of the ...nds and savanna under the present ... of fire control and no grazing is ...wn.

...mals believed to reside within or to ...rough the natural area are listed in ...I-1.

...erson (1970) has provided a rather ...te list of the bird species found on the ...l area and data on seasonal fluctuations ...ir abundance. He lists 13 resident ..., four occasional species, 13 summer ...ts, and 26 winter residents. Among ...rmanent residents are the hairy wood-... (*Dendrocopos villosus*), downy wood-... (*Dendrocopos pubescens*), scrub jay (...*ocoma coerulescens*), blackcapped chick-... (*Parus atricapillus*), common bushtit (...*iparus minimus*), white-breasted nut-... (*Sitta carolinensis*), brown creeper (...*a familiaris*), Bewick's wren (*Thryo-... bewickii*), robin (*Turdus migratorius*), ...-sided towhee (*Pipilo erythrophthal-...*) and Oregon junco (*Junco oreganus*).

...ORY OF DISTURBANCE

...an activities have significantly in-...d natural processes on the natural ...As mentioned, fire control activities ...d upon settlement of the valley prob-...ontributed to the development of the ... oak stands. The tract was heavily ... by sheep and cattle until 1966. Some ...cutting of oaks was also carried out ... establishment of the refuge. A rock ... is located on the south side of Pigeon

RESEARCH

Several studies have been carried out within the Pigeon Butte Research Natural Area. The tract was used as a sampling site by Thilenius (1964, 1968) during ecological studies of Willamette Valley oak woodlands. Anderson (1970) used the natural area as one site in a study of bird fauna in Oregon white oak stands. Several classes in ecology and wildlife at Oregon State University, Corvallis, have utilized the natural area; details are available from the Refuge Manager.

The natural area is extremely valuable as a tract where near-natural communities typical of those found in the Willamette Valley can be studied; protected stands of Oregon white oak are extremely rare. Studies of the composition and structure and of successional and environmental relationships of Oregon white oak stands are especially appropriate. Since two natural areas representing other Willamette Valley vegetation types are nearby (Maple Knoll and Willamette Floodplain), it is also possible to use the tract as one site in studies concerning the entire valley mosaic.

MAPS AND AERIAL PHOTOGRAPHS

Special maps available include the following: *Topography* — 15′ Monroe, Oregon quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1957; *geology* — *Geology of the West Central Border Area of the Willamette Valley, Oregon*, scale 1:62,500 (Vokes et al. 1954). Aerial photos taken in June 1970 may be purchased from the Agricultural Stabilization and Conservation Service, Benton County ASC Committee, P. O. Box 1027, Corvallis. Photo DFJ-1LL-49 provides the best coverage of the natural area.

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upialia	*Didelphis marsupialis*	opossum
tivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
ptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
ntia	*Eutamias townsendi*	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus canicaudus	gray-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma fuscipes	dusky-footed wood rat
	Peromyscus maniculatus	deer mouse
	Sciurus griseus	western gray squirrel
	Spermophilus beecheyi	California ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys bulbivorus	giant pocket gopher
ivora	*Canis latrans*	coyote
	Lynx rufus	bobcat
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
dactyla	*Odocoileus h. columbianus*	black-tailed deer

Figure Pl-1.– Aerial photograph of Pigeon Butte Research Natural Area, Benton Coun
Oregon, showing boundaries, vegetative patterns, and other features.

Figure Pl-2.—Natural features of Pigeon Butte Research Natural Area. Upper left: Typical closed stand of Oregon white oak near summit of Pigeon Butte. Upper right: Grassland and oak savanna near summit of Pigeon Butte. Center left: Oregon white oak stand showing abundant liana-form *Rhus diversiloba*. Center right: Large old-growth Oregon white oak trees of open-grown form within a closed forest stand; these are believed to be remnants of an oak savanna which originally occupied the area prior to initiation of fire control programs a century ago. Bottom: General view of Pigeon Butte and its environs from the north; the eastern edge of the Maple Knoll Research Natural Area is visible to the right of Pigeon Butte.





NE CREEK RESEARCH NATURAL AREA[1]

onderosa pine/bunchgrass on the acially eroded Channeled Scab- nds of east-central Washington.

Pine Creek Research Natural Area was shed in December 1966 to exemplify ely undisturbed savanna of ponderosa *Pinus ponderosa*) and bunchgrasses n the forest-grassland transition at the astern edge of eastern Washington's s. The 65-ha. (160-acre) tract is located okane County, Washington, and is istered by the Turnbull National Wild- fuge (Route 3, Box 107, Cheney, Wash-), Bureau of Sport Fisheries and Wild- is a long and narrow tract located in 5, T. 22 N., R. 42 E., Willamette an, at 47°25′ N. latitude and 117°31′ gitude (fig. PN-1).

ESS AND OMMODATIONS

each the natural area, travel south from on the Cheney-Plaza county road for . (4 miles), then 3.2 km. (2 miles) the Refuge headquarters, where de- directions will be provided. Access is nt during the summer and good during ter. Public accommodations are avail- Cheney.

RONMENT

Pine Creek Research Natural Area from 687 to 716 m. (2,250 to 2,350 ft.) in elevation. The undulating to rolling topography is typical of the eastern Washington Columbia Plateau.

The natural area is located on eastern Washington's well-known Channeled Scablands (Bretz 1959). The Columbia River basalts which characterize the entire Columbia Plateau provide the foundation of this landscape. An intricate network of drainage channels is carved into this bedrock and an overburden of loess. Glacial damming of the Columbia River by a lobe of the continental ice sheet is believed to have combined with successive massive floods released from glacially dammed lakes to produce the scablands. The natural area itself does not appear to have been directly glaciated.

A modified maritime climate prevails. Most precipitation occurs as rain or snow during the cool, cloudy winter. Summers are warm, generally low in precipitation, and largely cloudless. One to 3 months of drought are common. Climatic data from Spokane, located 29 km. (18 miles) northeast of the site are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	8.8°C.	(47.8°F.)
Mean January temperature	−3.7°C.	(25.3°F.)
Mean July temperature	21.4°C.	(70.5°F.)
Mean January minimum temperature	−7.7°C.	(18.1°F.)
Mean July maximum temperature	28.7°C.	(83.7°F.)
Average annual precipitation	437 mm.	(17.2 in.)
June through August precipitation	56 mm.	(2.2 in.)
Average annual snowfall	147 cm.	(58.0 in.)

Soils in the area were mapped between 1955 and 1961. Complete information, using soil names and descriptions approved in 1965, is found in the Spokane County Soil Survey (Donaldson and Giese 1968). Nearly all of the soils in the natural area are mapped as Hesseltine very rocky complex, 0- to 30-percent slopes. This complex consists of from 25 to 50 percent of basalt rock outcrops and

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ription prepared by Dr. F. C. Hall, U.S. ent of Agriculture, Forest Service, Region 6, , Oregon.

programs.

This area has not been grazed, logged, or otherwise disturbed since establishment of the Refuge in 1937. However, stumps clearly show that much of the old-growth ponderosa pine was removed many years ago.

The presence and often dominance of cheatgrass and Japanese brome in many stands also suggest that heavy livestock use prior to Refuge establishment has affected the vegetation, particularly in the more open plant communities; consequently, the area must be considered disturbed by livestock grazing. No other serious disturbances are known.

RESEARCH

Some research on the Pine Creek Research Natural Area is being conducted by ecology students at Eastern Washington State College, Cheney, Washington. Information on these investigations may be obtained from the Refuge Manager or from the Biology Department at Eastern Washington State College.

Voucher specimens of some bird and animal species and most plant species are available at Refuge Headquarters for inspection.

The natural area provides interesting research opportunities on (1) natural development of plant communities without land treatment measures, a situation nearly impossible to find in this locality; (2) elevations of the interface between forest communities and nonforest, moist or wet marsh communities; and (3) evaluation of faunal activity in a natural plant community lacking current human disturbance.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic maps which are sufficiently detailed to be useful are known for the natural area. The Wildlife

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d basalt bedrock. Small areas of Cocollala ty clay loam, a poorly drained meadow il, are also present. Hesseltine-type soils e associated with forest communities and eadows with the Cocollala type. Semiahmoo uck is found in the potholes.

IOTA

Estimated areas by community are as lows:

Name	*Area*
us ponderosa/Festuca	
dahoensis	54 ha. (135 acres)
pulus tremuloides meadow.......	8 ha. (20 acres)
ttle lakes and potholes	2 ha. (5 acres)

e *Pinus/Festuca* communities are probably signable to SAF cover type 237, Interior nderosa Pine (Society of American Forters 1954) and Küchler's (1964) Type 11, estern Ponderosa Forest. The meadows th quaking aspen (*Populus tremuloides*) n probably be classified as SAF type 217, spen. The area falls within a zone of pondesa pine savanna at the transition from closed rest to steppe vegetation (Daubenmire and ubenmire 1968).

The ponderosa pine forest is characterisally rather open with 25- to 40-percent own cover and ground vegetation dominated Idaho fescue (*Festuca idahoensis*) and eatgrass (*Bromus tectorum*) (fig. PN-2). is plant community comprises 70 to 80 rcent of the forested area. Other common derstory species are *Bromus japonicus*, *commutatus*, *B. mollis*, *Koeleria cristata*, *tentilla glandulosa*, *Erigeron* spp., and *eracium scouleri*. The soils typically are riable in depth with some areas exceeding dm. (40 in.) and others where bedrock is posed (fig. PN-2).

Microtopographic swales within the forted area are dominated by ponderosa pine *tostaphylos uva-ursi*. Soils in these microtopographic swales generally consist of layer of aerially deposited volcanic ash ove glacial outwash.

The *Pinus/Festuca* communities are correlated with Daubenmire's *Pinus ponderosa Festuca idahoensis* habitat type, and th *Pinus/Calamagrostis* stands might be considered disjunct variants of his *Pseudotsug menziesii/Calamagrostis rubescens* habita type (Daubenmire and Daubenmire 1968).

In a portion of the southern half of th natural area, stone polygons surround area of deeper soil on which occasional ponderos pine may be found. The nonforested plan community found there is presently dominate by dense stands of cheatgrass on deeper so and very sparse cheatgrass on stony soils At least five species of lichens grow on th exposed rocks. This plant community i probably closely related to the lithosoli phase of Daubenmire's (1970) *Agropyro spicatum/Poa sandbergii* habitat type.

Much of the quaking aspen meadow occur as a border type or ecotonal vegetation alon the edges of meadows or swamps (fig. PN-2).

A portion of the area classed as kettl lakes and potholes is covered by moist mea dows dominated by *Phalaris arundinace* along with some *Deschampsia caespitos* (fig. PN-2). Most potholes in this natural are have standing water for most of the growin season and are dominated by *Scirpus validu* and/or *Scirpus acutus* (fig. PN-2). Becaus of the high water table and high organi matter content of the soil, probably Semiahmoo muck (Donaldson and Giese 1968), fe other plants are found in these potholes. The are commonly bordered by the aspen meado community.

Animals believed to utilize the natura area as residents or transients are listed i table PN-1. A rather complete list of residen and migratory fauna can be obtained from th Refuge Manager.

roptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis lucifugus	little brown myotis
	Myotis subulatus	small-footed myotis
	Myotis yumanensis	Yuma myotis
	Pipistrellus hesperus	western pipistrel
	Plecotus townsendi	Townsend big-eared bat
omorpha	*Lepus californicus*	black-tailed jack rabbit
	Sylvilagus nuttalli	mountain cottontail
entia	*Erethizon dorsatum*	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Marmota flaviventris	yellow-bellied marmot
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus pennsylvanicus	meadow vole
	Neotoma cinerea	bushy-tailed wood rat
	Onychomys leucogaster	northern grasshopper mouse
	Perognathus parvus	Great Basin pocket mouse
	Peromyscus maniculatus	deer mouse
	Reithrodontomys megalotis	western harvest mouse
	Spermophilus columbianus	Columbian ground squirrel
	Tamiasciurus hudsonicus	red squirrel
	Thomomys talpoides	northern pocket gopher
ivora	*Canis latrans*	coyote
	Lynx rufus	bobcat
	Mephitis mephitis	striped skunk
	Mustela frenata	long-tailed weasel
	Taxidea taxus	badger
odactyla	*Odocoileus virginanus*	white-tailed deer

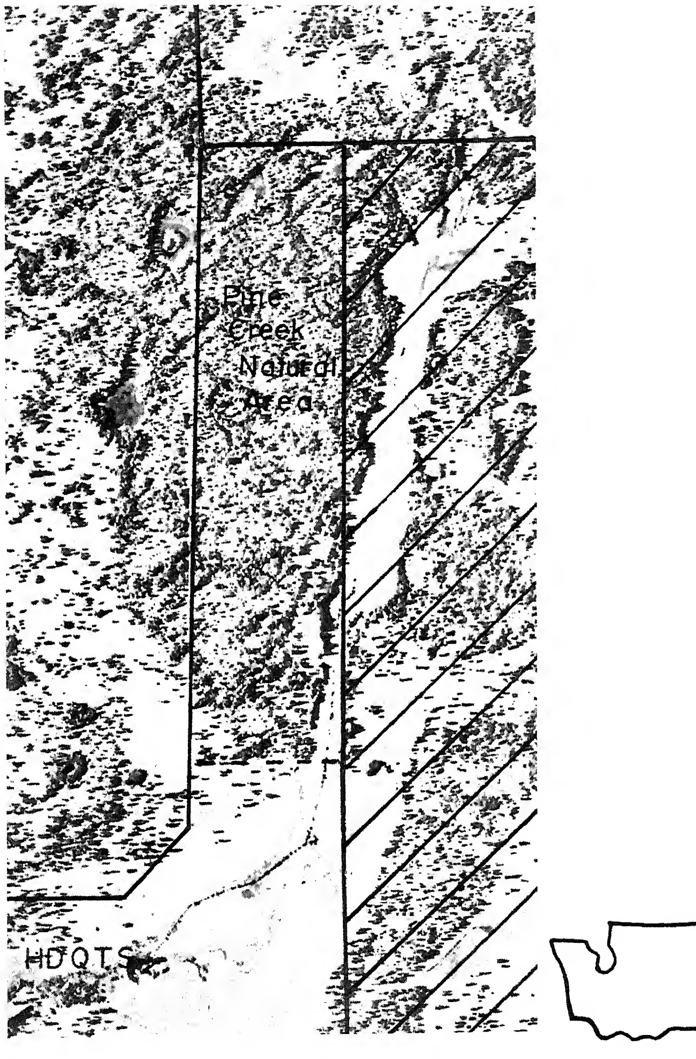
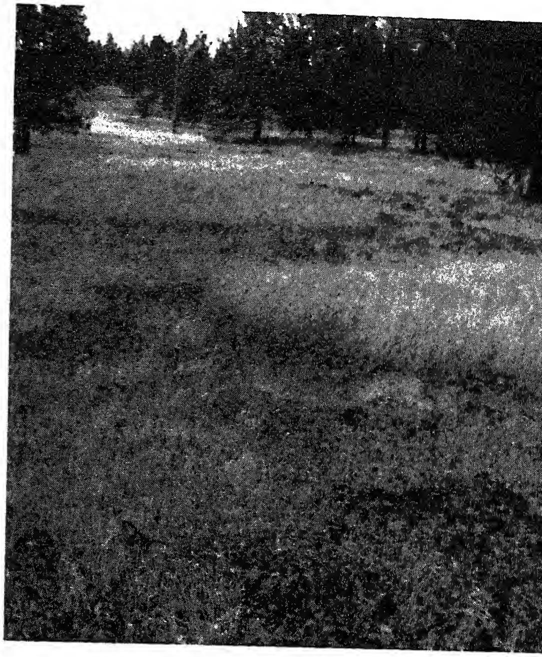


Figure PN-1.– Pine Creek Research Natural A
Spokane County, Washington.

½ MILE

Figure PN-2.—Communities in the Pine Creek Research Natural Area. Upper left: *Pinus ponderosa/Festuca idahoensis* stands with some cheatgrass are the most common community on gently mounded uplands; note exposed bedrock in background. Upper right: Network of very stony soil surrounding mounds of deep soil; mounds are dominated by cheatgrass; rocky areas support at least five species of lichen. Lower left: Moist meadow at the southeast edge of the natural area dominated by *Phalaris arundinacea*. Lower right: *Scirpus* marsh near center of the tract which has seasonal standing water; quaking aspen occurs along the edges.

PORT ORFORD CEDAR RESEARCH NATURAL AREA[1]

Port-Orford-cedar and Douglas-fir growing on a rugged, geologically diverse site on the southwestern Oregon Coast Ranges.

The Port Orford Cedar Research Natural rea was established on October 26, 1937, s a sample of virgin old-growth Port-Orford-edar (*Chamaecyparis lawsoniana*). The 454-a. (1,122-acre) tract is located in Coos ounty, Oregon, and is administered by the owers Ranger District (Powers, Oregon), iskiyou National Forest. The natural area ccupies section 35, a portion of the E½ of ection 34 located south of Johnson Creek, hat part of section 26 located south of John-on Creek and west of the Coquille River, nd a small part of section 36 which lies est of the Coquille River, all in T. 32 S., . 12 W., Willamette meridian (fig. PO-1). t lies at 42°45′ N. latitude and 124°05′ /. longitude.

CCESS AND CCOMMODATIONS

Primary access is via Powers, Oregon, hich lies 29 km. (18 miles) south of State ighway 42 on State Highway 242 and about 4 and 48 km. (21 and 30 miles) from Myrtle oint and Coquille, respectively. To reach ne vicinity of the natural area, travel south om Powers on Forest Road 333 for about 29 km. (18 miles). The natural area can be reached from Gold Beach on U.S. H way 101 by traveling east along the Ro River to Agness and then north on Fo Road 333.

There are no roads or trails within Port Orford Cedar Research Natural A although remains of an old trail can be fo along part of the southern boundary. Entra into the area is difficult, involving eit bush-whacking or wading. For access to southeast and eastern portions of the natu area, cross the bridge at Ferris Ford W Center (opposite Daphne Grove Forest Can hike uphill along the south boundary several hundred yards and penetrate natural area at or above the 380 m. (1, ft.) contour. To reach the southwestern co and upper slopes of the natural area, fol Forest Road 333 south past Daphne Gr Forest Camp, thence on Forest Road 330 the head of Jim Hayes Creek and the to the ridge, and walk north through a clea into the natural area. Access is also poss by fording Johnson Creek (easiest at mouth) from Forest Road 326 or the So Fork of the Coquille River from Road 333.

The nearest commercial accommodati are in Powers, Myrtle Point, Coquille, Gold Beach. However, there are several proved forest camps along Forest Road in the vicinity of the natural area: Dap Grove, Myrtle Grove, and Boundary.

ENVIRONMENT

The Port Orford Cedar Research Natu Area is topographically rugged except occasional benches and some broad ridget Slopes are particularly steep along John Creek and the Coquille River. Elevati range from 259 m. (850 ft.) along th streams to nearly 760 m. (2,500 ft.) on

[1] Description prepared by Dr. J. F. Franklin, U.S. epartment of Agriculture, Forest Service, Pacific orthwest Forest and Range Experiment Station,

ler 1903, Wells 1955, Peck 1961, Baldwin Hess 1971) (fig. PO-2). Sedimentary erials (sandstones, siltstones, and conherates) make up most of the bedrock. The of these belong to the Galice Formation ch consists of "Dark gray to black argillite fine to medium grained sandstone with or amounts of conglomerate containing mentary clasts. . ." (Baldwin and Hess 1). This formation is Upper Jurrasic in The contact line between this formation the Middle Eocene Umpqua Formation ddle member) occurs along a fault line ch runs north and south along the eastern e of the natural area. Diller's (1903) pping indicated the Tyee Formation coned the Galice Formation directly in this a but this has been corrected by Baldwin Hess (1971). An intrusion of gabbro ers about 40 ha. (100 acres) in the south- corner of section 35. An extensive outpping of serpentinite occupies the northtern point of the natural area, and recent logical mapping of the Powers Quadrangle ldwin and Hess 1971) suggests this body ends much further south in the natural a than Diller (1903) indicates. Finally, a all outcrop of chert is located in the northst corner of the natural area along Johnson ek.

The climate is wet and mild. Precipitation seasonal, with a peak in January and cember and a minimum in July and Aug-. The summer drought period is more nounced than in the northern Oregon and shington coastal mountains. The following natic data are from the closest weather tion at Powers (U.S. Weather Bureau 5):

an annual temperature	12.0°C.	(53.6°F.)
an January temperature	6.6°C.	(43.8°F.)
an July temperature	17.6°C.	(63.6°F.)
an January minimum emperature	1.6°C.	(34.8°F.)
an July maximum temperature	25.0°C.	(77.0°F.)

isohyetal maps (Oregon State Water Resources Board 1959) indicate 2,500 to 2,800 mm. (100 to 110 in.) annual precipitation.

Soil profiles are not strongly developed in the area although soils are often deep. Soil surveys are not available, but most soils tend toward Reddish-Brown Lateritics with 5 to 10 cm. (2 to 4 in.) thick A1 horizons or Brown Podzolics with minimal A2 development and weak B2ir horizons. On some steep slopes and ridgetops, Lithosols with A1-AC-C horizon sequences are encountered.

BIOTA

Estimated areas by SAF cover types (Society of American Foresters 1954) are: Cover type 231, Port-Orford-Cedar-Douglas-Fir, 328 ha. (810 acres), and type 229, Pacific Douglas-Fir, 126 ha. (310 acres). The area falls within Küchler's (1964) Type 2, Cedar-Hemlock-Douglas Fir Forest and the *Tsuga heterophylla* Zone of Franklin and Dyrness (1969).

Douglas-fir (*Pseudotsuga menziesii*) and Port-Orford-cedar are the most important tree species present, composing approximately 75 and 25 percent, respectively, of the old-growth forests which dominate the areas (fig. PO-3). Grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), sugar pine (*Pinus lambertiana*), western white pine (*Pinus monticola*), and Pacific yew (*Taxus brevifolia*) are also present. Hardwoods are well represented although not usually in the highest canopy level. Tanoak (*Lithocarpus densiflorus*), golden chinkapin (*Castanopsis chrysophylla*), and Pacific madrone (*Arbutus menziesii*) are most abundant and widespread; occurrences of bigleaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), red alder (*Alnus rubra*) and California-laurel (*Umbellularia californica*) are more localized. Most of the natural area is covered with forests of large, old trees. Although ages are

d.b.h.

A variety of plant communities are found on the natural area. Typically, the stands have a dense understory of shrubs and small trees such as *Rhododendron macrophyllum*, *Vaccinium parvifolium*, *V. ovatum*, tanoak, golden chinkapin, *Gaultheria shallon*, and *Berberis nervosa*. *Rhododendron* may attain heights of 8 m. (25 ft.) and diameters of 10 to 15 cm. (4 to 6 in.). Herbaceous species include *Polystichum munitum*, *Galium triflorum*, *Oxalis oregana*, *Viola sempervirens*, *Goodyera oblongifolia*, *Rubus ursinus*, *Trillium ovatum*, *Whipplea modesta*, *Hierochloe occidentalis*, and *Linnaea borealis*. Succession generally seems to be toward replacement of the dominant Douglas-fir and Port-Orford-cedar by western hemlock. Hemlock seedlings and saplings are usually most abundant; those of grand fir and Port-Orford-cedar are less common or absent. However, sprout and seedling reproduction of tanoak is as abundant, or more so, than that of western hemlock in many stands, suggesting it may be a climax species.

Polystichum munitum dominates the understory on moister sites such as well watered slopes or in seep areas (fig. PO-3). A greater variety of herbs and greatly reduced shrub coverage are also typical. Western redcedar is generally found only on these sites. Tree regeneration is mainly western hemlock.

There are some areas of shallow rocky soil, where communities are dominated by tanoak and Pacific madrone 50- to 75-cm. (20- to 30-in.) d.b.h. The understory is very dense, with 100-percent canopy coverage of low trees and shrubs — *Rhododendron macrophyllum*, tanoak, *Vaccinium ovatum*, golden chinkapin, *Gaultheria shallon*, and *Berberis nervosa*. Herbs are few, but include unusual species such as *Hemitomes congestum*, *Boschniakia hookeri*, and *Habenaria unalaschen-*

and include a large variety of unders species (fig. PO-3). A community domin by Douglas-fir, Port-Orford-cedar, Califor laurel, and *Xerophyllum tenax* is typica some serpentines; *Erythronium oregan* *Hierochloe occidentalis*, *Synthyris renifor* *Rhododendron occidentale*, *Senecio bolan* *Iris innominata*, and *Berberis piperiana* typical associates. On the dry serpenti nose above the confluence of Johnson C and the Coquille River, the vegetation mosaic of trees, dense shrub thickets, grassy openings (fig. PO-3). Douglas western white pine, and Port-Orford-c are the major trees interspersed with thic of *Rhamnus californica* var. *occident* *Rhododendron occidentale*, and Canyon oak (*Quercus chrysolepis*). The grassy o ings are rich in species such as *Fes* *subuliflora*, *Cheilanthes siliquosa*, *S* *campanulata*, *Zigadenus fremontii*, *Brod* *coronaria*, *Calochortus tolmei*, *Casti* *pruinosa*, *Achillea millefolium*, *Erysi* *concinnum*, *Polystichum lonchitis*, *Loma* sp., and *Sedum spathulifolium*.

There are a number of wet benches swales within the natural area (fig. P Red alder, Oregon ash, and bigleaf m typify these areas as well as dense stand *Carex obnupta*, *C. amplifolia*, and o Cyperaceae.

Mammals believed to utilize the nat area as residents or transients are liste table PO-1. Roosevelt elk frequent the during the fall, winter, and spring. natural area also provides a rich variet habitats for amphibians. Among the spe occurring here are the Del Norte salamar (*Plethodon elongatus*), Dunn's salamar (*Plethodon dunni*), Pacific giant salamar (*Dicamptodon ensatus*), clouded salamar (*Aneides ferreus*), Oregon salamander (*satina escholtzii*), northwestern salamar (*Ambystoma gracile*), rough-skinned

have already been mentioned. These [de] lithosolic tanoak-Pacific madrone, serpentinite areas, and swales. There is a small, shallow pond (several acres in which appears to have been formed by [a]nd slump northwest of the center of the ¼ of section 35.

[HI]STORY OF DISTURBANCE

[T]here is evidence in fire scars on old [Dou]glas-fir and Port-Orford-cedar that ground [fire]s have burned through the area peri[odic]ally. None appears to have occurred in [rec]ent years. The introduced root pathogen, [Phy]*tophthora lateralis*, has not yet invaded [the] natural area to any substantial degree in [con]trast to the situation in the nearby Coquille [Riv]er Falls Research Natural Area. This [pat]hogen, which is invariably fatal to Port-[Orf]ord-cedar, has apparently killed only a [few] trees at the edge of the natural area — [alo]ng the South Fork of the Coquille River [and] at the head of Jim Hayes Creek. More [dam]age can be expected in the future.

[H]uman disturbance of the area is minimal. [The]re are remains of mine workings along [Joh]nson Creek on the north edge of the [nat]ural area. Approximately 3 ha. (7 acres) [on] the western edge of the natural area was [acc]identally clearcut when adjacent tracts [we]re logged about 15 years ago.

[RE]SEARCH

[T]here are no research studies in progress [in] the Port Orford Cedar Research Natural [Ar]ea. Some data on community structure and [lim]ited plant collections have been obtained

dynamics, and soil development on widely varying parent materials, and (2) the fauna and flora of an isolated pond. The possible eventual invasion of the area by *Phytophthora lateralis* makes community studies especially timely. The large number of southern or Californian species, especially on serpentinite, makes the area of special interest to the taxonomist or plant geographer.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* — 15′ Powers and Agness, Oregon, quadrangles, scale 1:62,500, issued by the U.S. Geological Survey in 1954; and *geology* — *Description of the Port Orford Quadrangle*, scale 1:250,000 (Diller 1903), *Geologic Map of the Powers Quadrangle, Oregon*, scale 1:62,500 (Baldwin and Hess 1971), *Preliminary Geologic Map of Southwestern Oregon* . . ., scale 1:250,000 (Wells 1955), and *Geologic Map of Oregon West of the 121st Meridian*, scale 1:500,000 (Peck 1961). Either the District Ranger (Powers Ranger District) or Forest Supervisor (Siskiyou National Forest, Grants Pass, Oregon) can provide details on the most recent aerial photo coverage and forest type maps for the area.

Forest type and topographic maps (scale 3 in. = 1 mi., 50-ft. contour interval) prepared by Forest Service personnel in 1938 are on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, as are records of a 1938 cruise of the natural area.

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	*Scapanus orarius	coast mole
	Sorex bendirii	marsh shrew
	Sorex pacificus	Pacific shrew
	*Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
optera	Antrozous pallidus	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
morpha	Lepus americanus	snowshoe hare
ntia	Aplodontia rufa	mountain beaver
	Arborimus albipes	white-footed vole
	Arborimus longicaudus	red tree vole
	Castor canadensis	beaver
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	*Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Neotoma fuscipes	dusky-footed wood rat
	*Peromyscus maniculatus	deer mouse
	Spermophilus beecheyi	California ground squirrel
	*Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
vora	Bassariscus astutus	ringtail or miner's cat
	*Canis latrans	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	*Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
dactyla	Cervus canadensis roosevelti	Roosevelt elk
	*Odocoileus h. columbianus	black-tailed deer

sterisk (*) indicates habitation verified by

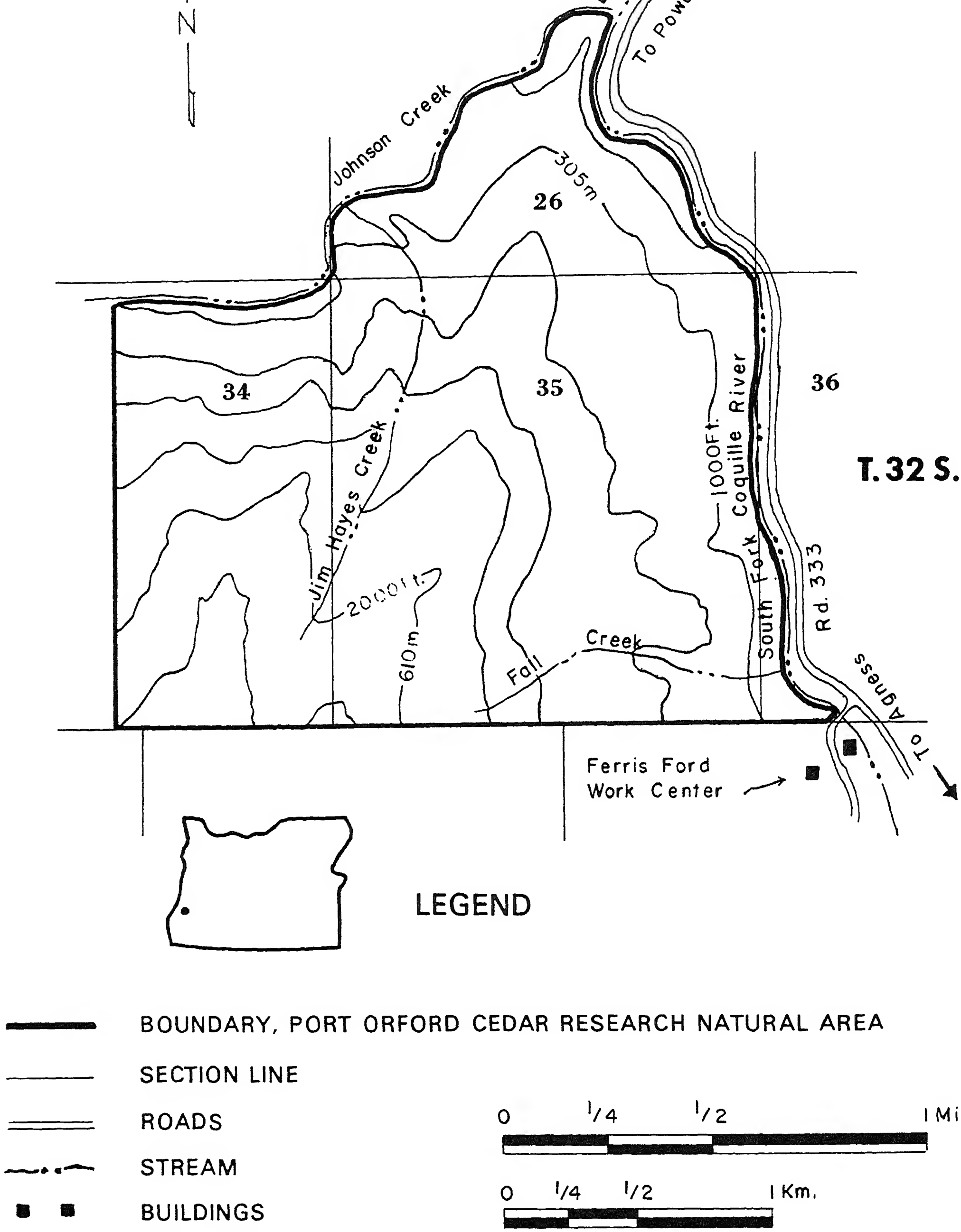
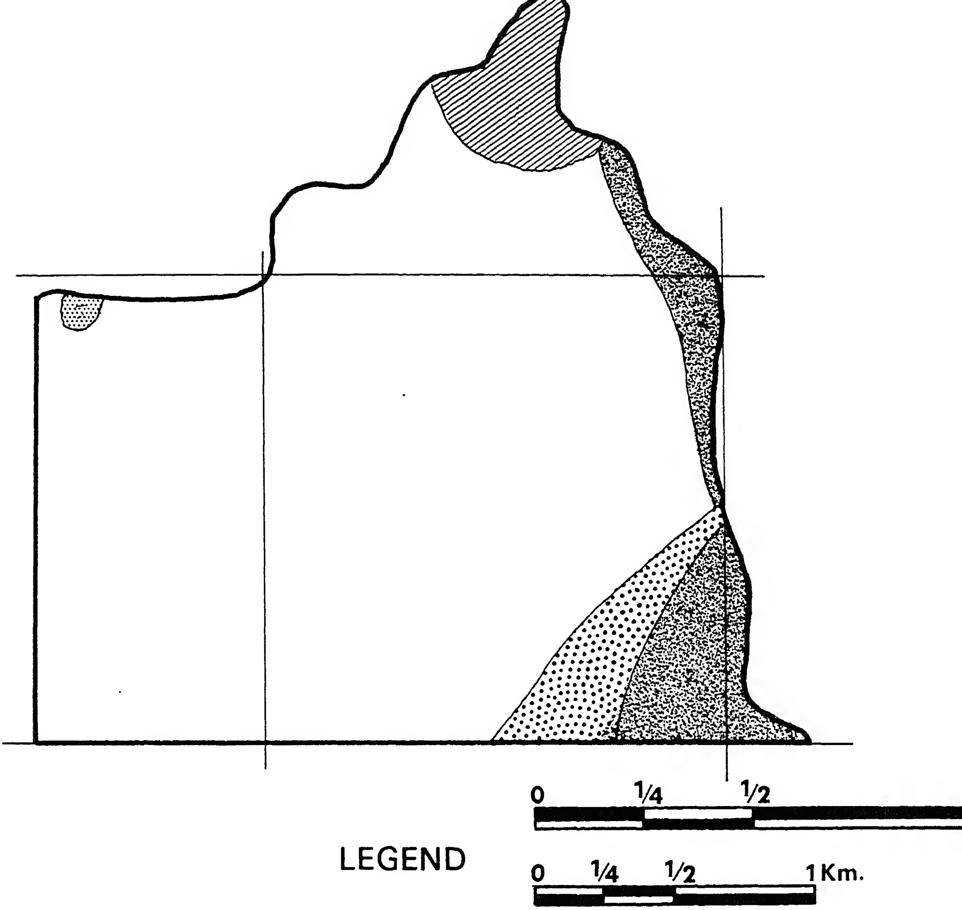


Figure PO-1.– Port Orford Cedar Research Natural Area, Coos County, Oregon.



LEGEND

GALICE FORMATION CRETACEOUS CONGLOMERATE, SANDSTONE, AND SH

UMPQUA (MIDDLE MEMBER) FORMATION
EOCENE YELLOWISH SANDSTONE, GRAY SHALES, AND CONGLOMERATE

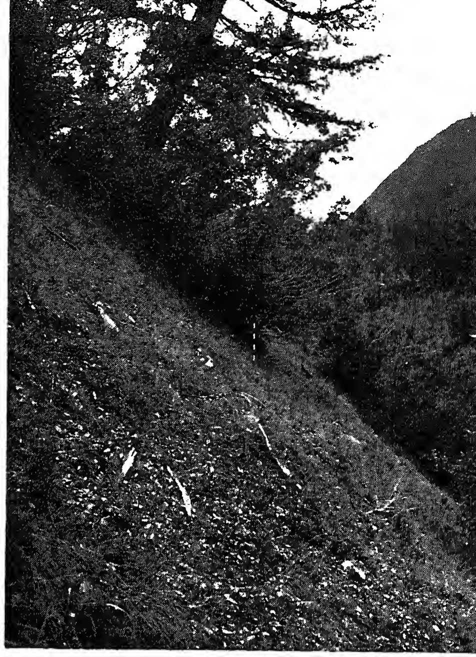
GABBRO DEEP-SEATED IGNEUS INTRUSIVE MASSES

SERPENTINITE PRIMARILY ALTERED PERIDOTITE

CHERT CREACEOUS SILICEOUS SHALE AND GRAY AND RED JASPERRY ROCKS

Figure PO-2.– Geology of Port Orford Cedar Research Natural Are (after Diller 1903); recent mapping indicates the Serpentinite extends further south than is shown her (Baldwin and Hess 1971).

Figure PO-3.—Communities in the Port Orford Cedar Research Natural Area. A: Mixed stand of grand fir, bigleaf maple, and western hemlock on a wet bench; understory dominated by *Polystichum munitum.* B: Open vegetational mosaic on serpentinite ridge with stunted Douglas-fir, Canyon live oak, and *Rhamnus californica; Festuca* spp. and forbs occupy the openings. C: Mixed stand of Port-Orford-cedar and Douglas-fir on uplands, average d.b.h. 100-cm. D: Swale dominated by red alder and *Carex obnupta.*



B

D

Figure PO-3.—Communities in the Port Orford Cedar Research Natural Area (continued). E: Extensive swale on slump bench dominated by Oregon ash and *Carex obnupta.* F: Mixed forest stand located on serpentinite; Douglas-fir dominates, but Port-Orford-cedar (center) and Pacific madrone (center and right) are also present in the overstory and *Xerophyllum tenax* and tanoak in the understory. G: Typical mixed upland forest dominated by Douglas-fir, Port-Orford-cedar, and western hemlock, with tanoak and *Polystichum munitum* in the understory; note the bigleaf maple in the background (just left of center). H: Forest stand on one of the infrequent benches found along the South Fork of the Coquille River; the river forms the natural area boundary in this area.

F

H

PRINGLE FALLS RESEARCH NATURAL AREA[1]

A two-unit natural area containing ponderosa pine/bitterbrush and lodgepole pine/bitterbrush communities typical of the northern Mount Mazama pumice area in south-central Oregon.

The Pringle Falls Research Natural Area was established June 1936, to exemplify the topographically related mosaic of lodgepole pine (*Pinus contorta*) and ponderosa pine (*Pinus ponderosa*) forests characteristic of a large area of aerially-deposited Mount Mazama (Crater Lake) pumice in south-central Oregon. The 470-ha. (1,160-acre) tract is located in Deschutes County, Oregon, and is administered by the Bend Ranger District (Bend, Oregon), Deschutes National Forest. It is also a part of the Pringle Falls Experimental Forest, a 4,477-ha. (11,055-acre) area maintained by the Pacific Northwest Forest and Range Experiment Station for research and demonstration of management techniques in ponderosa and lodgepole pine forests (Mowat 1954). The natural area is in two units. Unit 1, the western block, contains 227 ha. (560 acres) and includes nearly all of section 3, T. 21 S., R. 9 E., Willamette meridian; and Unit 2, the eastern block, contains 243 ha. (600 acres) and encompasses most of section 35 and a small portion of section 34, T. 21 S., R. 9 E., Willamette meridian (fig. PR-1). Both units lie at approximately 43°03′ N. latitude and 121°40′ W. longitude.

[1] Description prepared by Dr. F. C. Hall, U.S. Department of Agriculture, Forest Service, Region

ACCESS AND ACCOMMODATIONS

The natural area is located appro 57 km. (35 miles) southwest of B approximately 18 km. (11 miles) nor Lapine and is approached via U.S. 97 and Forest Service roads. Direc be obtained at the Silviculture Labo Ranger Station in Bend. Access to is good in the summer, but snow mak access difficult. In general, travel thr natural area is quite easy. Forest roa around the tracts and one traverses unit in an east-west direction (fig Several old trails provide access segments of both units (fig. PR-1). elevations at the northeast corner o unit can be reached via a logging roa

Public accommodations are ava Bend and Lapine; primitive cam are available at the northern edg experimental forest and at Wickiu voir 5 km. (3 miles) west of the area.

ENVIRONMENT

Topography and elevational rang on the two units of the natural are the western block, is located on n topography with a total elevationa 1,310 to 1,320 m. (4,290 to 4,310 ft. the eastern block, varies from flat to relatively steep on some slopes (f Elevations range from 1,310 to 1,470 to 4,820 ft.).

Both tracts are located on a pla which 3 to 12 dm. (2 to 5 ft.) pumice was aerially deposited foll eruption of Mount Mazama (no Lake) 6,600 years ago. Bedrock in is mapped as basalt and basaltic lavas of Pleistocene to Recent age

nerally low in precipitation and largely udless. One to 3 months of drought are nmon. Climatic data from Wickiup Reserr located 3 km. (2 miles) west of the tract e as follows (U.S. Weather Bureau 1965):

an annual temperature	5.7°C.	(42.3°F.)
an January temperature	−4.2°C.	(24.5°F.)
an July temperature	15.9°C.	(60.7°F.)
an January minimum emperature	−10.6°C.	(12.8°F.)
an July maximum emperature	26.8°C.	(80.3°F.)
erage annual precipitation	525 mm.	(20.7 in.)
ne through August orecipitation	58 mm.	(2.3 in.)

The principal soil in the area has been assified as the Lapine series (Tarrant 1947). ne Lapine soil is loamy coarse sand, textured d derived from aerially deposited dacite umice. It is well drained and occupies 2- 25-percent slopes. The pumice varies om 80 to 130 cm. (30 to 50 in.) in depth er buried soil profiles. A small area in the orthern half of Unit 1, which is easily cognized by its grass dominated underory, is covered by the Wickiup soil series. ne Wickiup is also a loamy coarse sand il formed in aerially deposited dacite pumice. differs from the Lapine by having a seanally high water table. The Wickiup occurs slopes of 0 to 5 percent and on pumice posits ranging from 130 to 150 cm. (50 to) in.) in depth.

Wickiup Reservoir, located 3 km. (2 miles) ove and to the west of the natural area, has pparently influenced the level of the water bles in this locality. Small ponds and lakes 5 to 1 km. (0.25 to 0.5 mile) west of Unit 1 ave had water levels raised from 1 to 1.5 m. to 5 ft.) since installation of the reservoir.

OTA

Estimated areas by plant community are:

contorta/Purshia tridentata		(300 acres
Pinus ponderosa-Pinus lambertiana/Ceanothus velutinus		26 ha. (65 acres
Pinus contorta/Purshia tridentata	226 ha. (560 acres)	16 ha. (40 acres

The distribution of community types, a defined by timber and ground vegetation typ maps prepared in 1934, is illustrated i figure PR-2. Both *Pinus ponderosa/Pursh tridentata* and *Pinus ponderosa-Pinus con torta/Purshia tridentata* can be assigned t SAF forest cover type 237, Interior Ponderos Pine (Society of American Foresters 1954 and Küchler's (1964) Type 10, Ponderos Pine Shrub Forest. *Pinus ponderosa-Pinu lambertiana/Ceanothus velutinus* commun ties could probably be assigned to SAF fore cover type 243, Ponderosa Pine-Sugar Pin Fir, and Küchler's Type 5, Mixed Coniferou Forest. *Pinus contorta/Purshia tridenta* stands can be categorized as SAF forest cove type 218, Lodgepole Pine; Küchler does n recognize lodgepole pine type. The natur area falls within a *Pinus ponderosa* Zon according to Dyrness and Youngberg (1966 The very recent, 6,600-year-old, pumice d posit has not weathered to produce zon type soils; therefore it is difficult if n impractical to assign the area to a "climat vegetation zone."

Unit 1, the western block, is complete dominated by pure or nearly pure lodgepo pine. Eighty to 90 percent of the area characterized by lodgepole pine and bitte brush (*Purshia tridentata*) with a spar herbaceous cover composed of western needl grass (*Stipa occidentalis*), Ross's sedge (*Car rossii*), bottlebrush squirreltail (*Sitani hystrix*), and *Fragaria cuneifolia* (fig. PR-3 A lodgepole stand with strikingly differe ground vegetation occurs in the northe half of the area (figs. PR-2 and PR-3): He the ground vegetation is codominated bitterbrush and Idaho fescue (*Festuca id hoensis*) with *Arctostaphylos uva-ursi*, *Ach*

Unit 2, the eastern block, has smaller amounts of pure lodgepole pine (fig. PR-2). Its undulating to rolling topography is associated with stands of ponderosa pine, bitterbrush, and western needlegrass (Dyrness and Youngberg 1966) (fig. PR-3). In some cases, particularly on concave lower slopes, lodgepole pine grows in association with ponderosa. Ponderosa pine and bitterbrush are the conspicuous overstory and ground vegetation dominants, respectively; in addition, Ross's sedge, western needlegrass, bottlebrush squirreltail, and, at times, *Arctostaphylos parryana* var. *pinetorum* are present. At higher elevations and on northerly slopes, sugar pine (*Pinus lambertiana*) and white fir (*Abies concolor*) become significant elements in the plant community. Associated with the increase in these tree species is a decrease in bitterbrush, an increase in *Arctostaphylos*, and occurrence of *Ceanothus velutinus*.

Mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus canadensis*) use the area as spring-summer and fall range. Other mammals believed to utilize the area as residents or transients are listed in table PR-1.

HISTORY OF DISTURBANCE

Fire scars on ponderosa pine indicate ground fires periodically burned the area prior to initiation of fire control programs in 1910 (fig. PR-3); general fires are indicated in 1605, 1672, 1716, 1731, 1769, 1788, 1823, 1855, 1871, and 1886. Lack of dominant old-growth fir in the presence of abundant fir reproduction further suggests most portions of the ponderosa forest have burned at some time. In many cases, charred trees and logs are in evidence in lodgepole pine communities suggesting fire also has occurred in these areas.

Domestic sheep apparently grazed the area at one time on their way to high elevation past... Utilization ... bitterbrush. No other significant disturbance is known.

RESEARCH

Since the natural area is a part of the Pringle Falls Experimental Forest, a great deal of research has been and is being conducted on the tract. Two fenced areas were established in each block about 1934 providing 8 ha. (20 acres) in the east unit and 6 ha. (15 acres) in the west unit from which grazing has been excluded for about 35 years (fig. PR-2). These plots contain permanent points which have been photographed at least twice. The two plots in the eastern unit (plots ... and 28) are also sites where periodic measurements are made of forest growth and mortality. Between 1938 and 1948, annual gross increment of ponderosa pine averaged 1.65 cu. m. per ha. per year (118 bd. ft. per acre per year) and mortality averaged ... cu. m. per ha. (50 bd. ft. per acre) resulting in a net growth of 0.95 cu. m. per ha. per year (68 bd. ft. per acre per year). Most mortality was caused by western pine barkbeetle (*Dendroctonus ponderosae*). A portion of the natural area has also been used as a baseline data source in studies of the epidemiology of tree-killing insects, including the bark beetle, by the now-defunct Bureau of Entomology and Plant Quarantine.

Baseline population levels of several bird and mammal species are also being studied on both units of the Pringle Falls Research Natural Area.[2] This is part of a larger, long-term eastern Oregon study utilizing several other Research Natural Areas representing different vegetation types. At present, research involves estimating breeding bird populations based upon weekly early morning censuses during the bird breeding season within a gridded area.

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[2] Research by Mr. Jay S. Gashwiler, Wildlife Research Biologist, Bureau of Sport Fisheries and Wildlife, ...

ol practices; and (3) undisturbed forest
mparison with similar tracts on the
imental forest which have been carefully
ged under controlled experimental
tions. The natural area also provides a
mark site for studies of undisturbed
ation over the range of south-central
on's pumice plateau area; Pringle Falls,
low Mountain, Bluejay, and Metolius
arch Natural Areas span the Mount
ma pumice deposits from south to north.
ingle Falls Research Natural Area is
a part of the Pringle Falls Experimental
st, which is similar in forest type and
onment. The possibility exists of using
parts of the experimental forest for
involving destructive sampling or mani
tion and using the natural area as a
rol.

PS AND AERIAL
OTOGRAPHS

everal special maps covering the natural
were prepared by Civilian Conservation
os crews during the 1930's and are on
at the Pacific Northwest Forest and Range
eriment Station's headquarters in Port
l or Silviculture Laboratory in Bend.
t of the maps have a scale of 1 inch equal
ile. Included are a topographic map with
)-foot contour interval and maps of tim
types, timber size classes, tree reproduc
density and species, and ground cover.
a from a timber cruise of the natural
a conducted at the same time are also
ile.

The District Ranger (Bend Ranger Dis
t), the Project Leader (Silviculture La
atory, Bend), or Forest Supervisor (Des
tes National Forest, Bend, Oregon) can

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of the High Cascade Mountai
State Dep. Geol. & Mi
Ind.

Youngberg, C. T., and W. G. Dahms
1970 Productivity indices for lodge

		wandering shrew
Chiroptera	[illegible]	big brown bat
	[illegible]	silver-haired bat
	[illegible]	red bat
	[illegible]	hoary bat
	[illegible]	California myotis
	[illegible]	long-eared myotis
	[illegible]	little brown myotis
	[illegible]	fringed myotis
	[illegible]	long-legged myotis
	[illegible]	Yuma myotis
	[illegible]	Townsend big-eared b
Lagomorpha	[illegible]	black-tailed jack rabb
	[illegible]	mountain cottontail
Rodentia	[illegible]	beaver
	[illegible]	porcupine
	[illegible]	yellow pine chipmunk
	[illegible]	northern flying squirr
	[illegible]	long-tailed vole
	[illegible]	mountain vole
	[illegible]	bushy-tailed wood rat
	[illegible]	deer mouse
	[illegible]	western gray squirrel
	[illegible]	mantled ground squir
	[illegible]	chickaree
	[illegible]	Mazama pocket gophe
	[illegible]	Pacific jumping mouse
Carnivora	[illegible]	coyote
	[illegible]	mountain lion or coug
	[illegible]	river otter
	[illegible]	bobcat
	[illegible]	marten
	[illegible]	striped skunk
	[illegible]	long-tailed weasel
	[illegible]	mink
	[illegible]	raccoon
	[illegible]	spotted skunk or civet
	[illegible]	badger
	[illegible]	gray fox
	[illegible]	black bear
	[illegible]	red fox
Artiodactyla	[illegible]	wapiti or elk
	[illegible]	mule deer

Habitat [illegible]

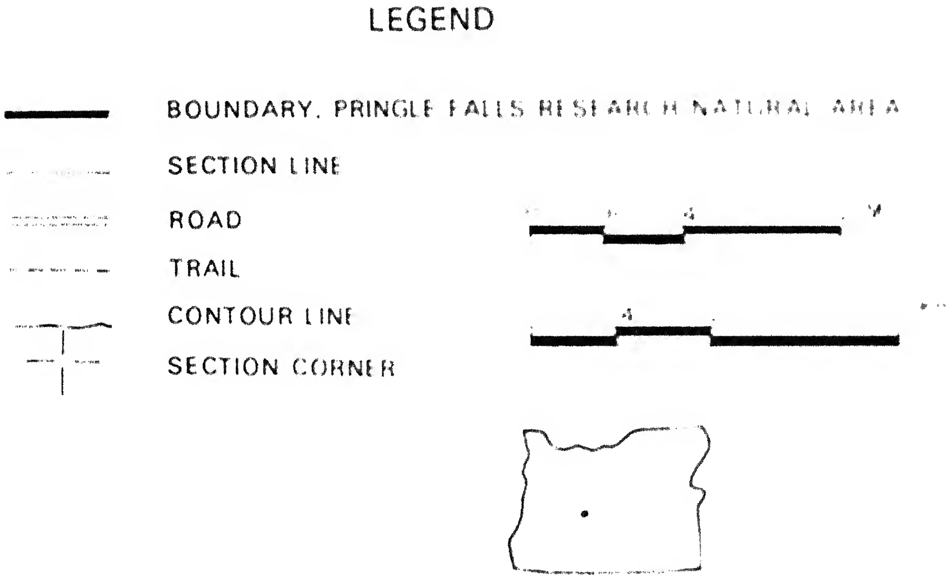
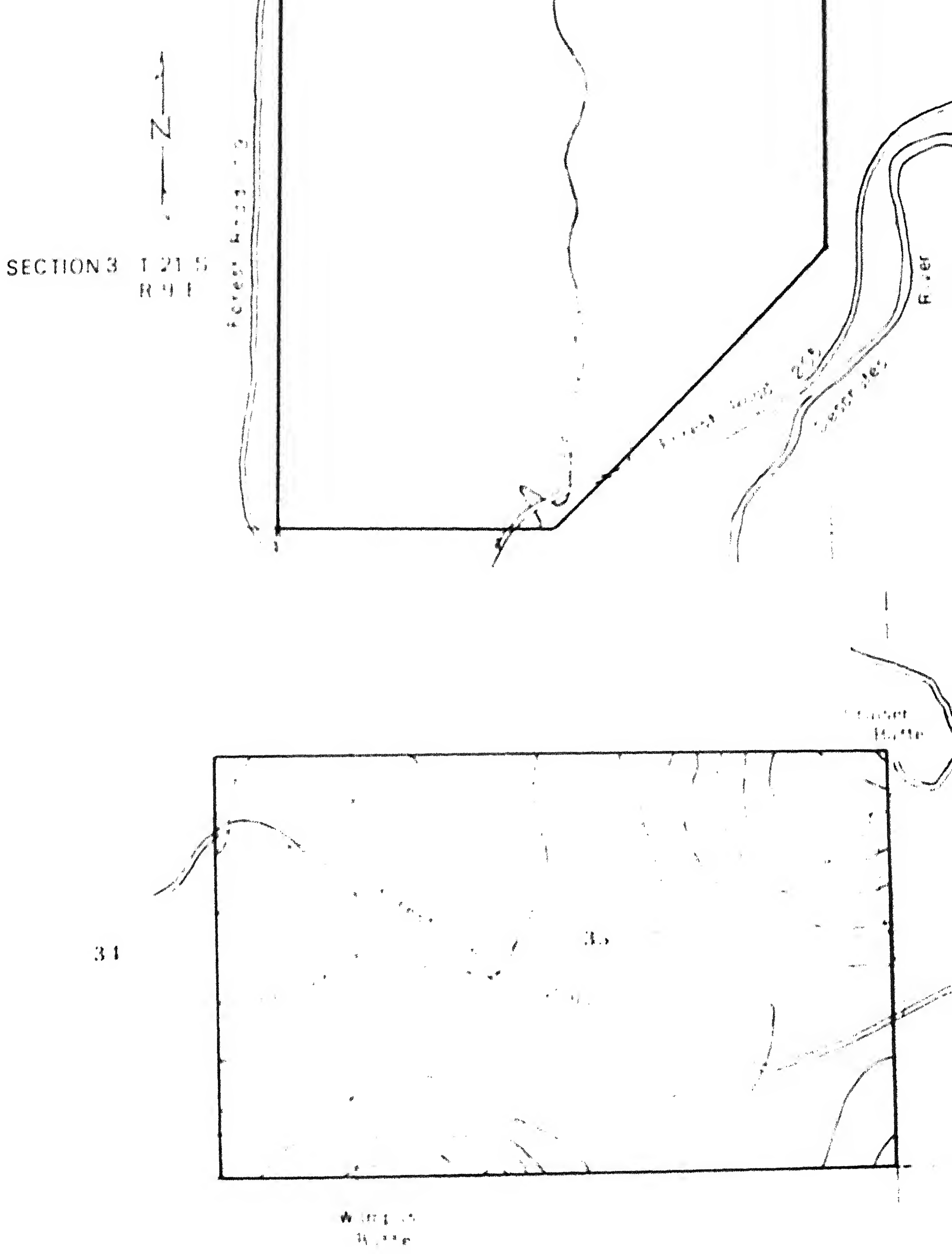


Figure PR 1 Pringle Falls Research Natural Area, Deschutes County, Oregon. Upper area is the west block and the lower area is the east blo(20-foot contour intervals.)


N
SECTION 3 T 21 S
R 9 E
31

LEGEND

Pinus contorta / GRASS

Pinus cortorta / Purshia tridentata

Pinus ponderosa – P. contorta / Purshia tridentata

Pinus ponderosa / Purshia tridentata

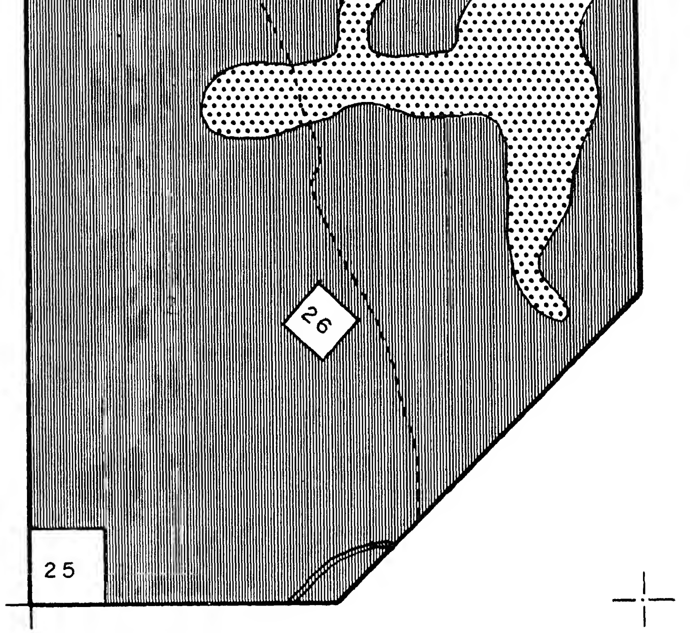
Pinus ponderosa – P. contorta / Ceanothus velutinus

Pinus ponderosa / Ceanothus velutinus

Pinus ponderosa – P. lambertiana / Ceanothus velutinus

28 ECOLOGICAL STUDY PLOTS

gure PR-2.– Distribution of forest community types on the Pringle Falls Research Natural Area


26
25

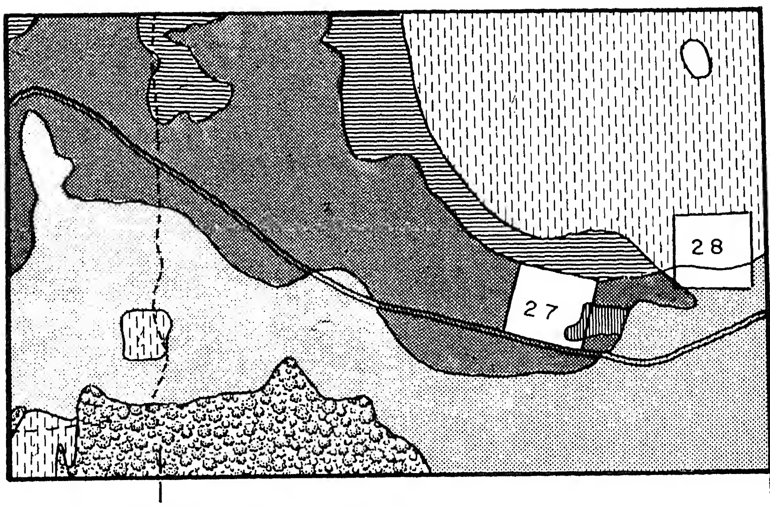

28
27

Figure PR-3.—Communities of the Pringle Falls Research Natural Area. Top: Ponderosa pine, bitterbrush, and western needlegrass stand typical of the east block; note fire scar on tree nearest the meter board. Lower left: Stand of lodgepole pine, bitterbrush, and western needlegrass typical of the west block. Lower right: Stand of lodgepole pine, bitterbrush, and Idaho fescue typically found on finer textured soils.

QUINAULT RESEARCH NATURAL AREA[1]

A coastal plain tract of western hemlock, Sitka spruce, western red-cedar, and Douglas-fir located on the southwestern edge of the Olympic Peninsula.

The Quinault Research Natural Area was stablished on June 18, 1932, as an example f Sitka spruce type in its natural state. The 94-ha. (1,468-acre) tract is located in Grays Iarbor County, Washington, and is adminis-ered by the Quinault Ranger District (Quin-ult, Washington), Olympic National Forest. 'he natural area occupies all except 2 ha. (5 cres) of section 31 and the W½ and W½ IE¼ of section 32, T. 23 N., R. 9 W., and he N½ of section 6 and W½ NW¼ of section , T. 22 N., R. 9 W., Willamette meridian. It es at 47°27′ N. latitude and 123°52′ W. ongitude.

CCESS AND CCOMMODATIONS

Access is via U.S. Highway 101 which rosses the west side of the Quinault Research Iatural Area (fig. QU-1) about 64 km. (40 niles) north of Hoquiam and 1.6 km. (1 mile) outh of Amanda Park. No other roads or rails enter the tract. Commercial accommo-ations as well as several excellent public ampgrounds are located 3 to 8 km. (2 to 5 niles) from the natural area in the vicinity of ake Quinault.

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station,

ENVIRONMENT

The Quinault Research Natural Area var from about 122 to 366 m. (400 to 1,200 in elevation with the bulk of the area at 1 to 152 m. (400 to 500 ft.). Topography is to gently rolling except along the eastern e where the steep lower slopes of Quina Ridge are encountered. Willaby and Boul Creeks flow through the tract, and seve of their small tributaries rise within it.

The natural area straddles the cont between marine terrace deposits of Pleis cene age and basalt flows and breccias for during the Eocene epoch (Huntting et 1961). The latter materials, belonging to Metchosin formation (Danner 1955), limited to the slope of Quinault Ridge. terrace deposits are covered with drift posited by alpine glaciers which occupied area three times during the Wisconsin and at least once, pre-Wisconsin (Cran 1964).

A maritime climate, wet with muted t perature extremes, prevails. Winters are n and summers are cool with frequent clo days. Precipitation is heavy but highly sonal with January and December the p months. Only about 7 percent of the ann precipitation falls during June, July, August, and some years a drought perio a month or more occurs. Snow is rare. Clim data from the nearby Quinault Ranger tion are as follows (U.S. Weather Bur 1956):

Mean annual temperature	10.6°C.	(51.
Mean January temperature	3.8°C.	(38.
Mean July temperature	17.3°C.	(63.
Mean January minimum temperature	1.2°C.	(34.
Mean July maximum temperature	23.8°C.	(74.
Average annual precipitation	3,371 mm.	(132.7
June through August precipitation	244 mm.	(9.6

ssed as Sols Bruns Acides. Soils on gentle
ography are underlain by compacted
cial till.

OTA

Estimated areas by SAF cover types (So-
ty of American Foresters 1954) are:

o.	*Name*	*Area*
4	Western Hemlock	314 ha. (775 acres)
5	Sitka Spruce-Western Hemlock	162 ha. (400 acres)
7	Western Redcedar-Western Hemlock	81 ha. (200 acres)
0	Douglas-Fir-Western Hemlock	24 ha. (60 acres)

The area would probably fall entirely with- Küchler's (1964) Type 1, Spruce-Cedar- mlock Forest, and the *Picea sitchensis* ne as defined by Franklin and Dyrness 969).

Western hemlock (*Tsuga heterophylla*), ka spruce (*Picea sitchensis*), Douglas-fir *seudotsuga menziesii*), and western red- dar (*Thuja plicata*) dominate the Quinault search Natural Area. Although all four ecies are distributed throughout the area, ere tend to be local concentrations (fig. J-1). Sitka spruce is best represented in e central portion of the natural area but es not occur as a pure stand. Western hem- ck is the most abundant species and occurs a pure or nearly pure type (80 percent by lume) on some of the slopes along the stern boundary. It also dominates a com- ratively young stand along the western undary. Western redcedar is most abundant the northwestern corner of the tract. ouglas-fir dominates a small knoll in the nter of the tract and a well-drained area ong the northwest boundary. Pacific silver (*Abies amabilis*) is found in small numbers ong the lower slopes of Quinault Ridge.

The forests on the natural area vary widely size and age. The oldest and largest western hemlocks are generally much young- er, perhaps 150 to 200 years in age in the central portion of the natural area. The spruce dominants are in excess of 75 m. (250 ft.) tall and have diameters averaging 90 to 10(cm. (35 to 40 in.) b.h. and, not infrequently reaching 150 to 180 cm. (60 to 70 in.) b.h Hemlocks are generally somewhat smaller The stand of young western hemlock along the western boundary has trees averaging 50- to 60-cm. (20- to 24-in.) d.b.h.

Succession in the Quinault Research Na- tural Area is primarily toward replacemen of existing mixed forests by western hemlock Only western hemlock is consistently repre- sented in all age classes. Seedlings and sap- lings of hemlock are abundant; some stan openings are completely choked by saplin hemlocks (fig. QU-2). Reproduction of wester redcedar and Douglas-fir is almost universall absent. Small Sitka spruce seedlings ar common, especially on rotten logs, but the are not so abundant as those of hemlock, an sapling spruce are rarely found under stands Open, wet depressions dominated by larg old western redcedar and Sitka spruce pro vide a possible successional exception; spruc saplings are almost as abundant in thes areas as those of hemlock. Along Quinau Ridge, Pacific silver fir is reproducing unde closed forests and will apparently be a pa of the climax forest.

Most tree reproduction is found on rottin logs, "nurse logs," which often suppo hundreds of hemlock and spruce seedling (fig. QU-2). Some of these survive and the roots reach mineral soil. The consequenc are visible throughout the area as lines mature trees growing along the remains the original nurse logs (fig. QU-2).

The understory is luxuriant throughou although relatively poor in species of vascul plants (fig. QU-2). *Vaccinium parvifoliu Polystichum munitum*, and *Oxalis orega* are major dominants. *Tiarella trifoliata, Ga*

derably. Species there include *Rubus spectabilis*, vine maple (*Acer circinatum*), *Viola labella*, *Trillium ovatum*, *Cardamine* sp., *alium aparine*, *Rhamnus purshiana*, and everal Cyperaceae.

Since the natural area lies within the so-alled "rain forest" region of the western lympic Peninsula, mosses and liverworts anket the ground, down logs, shrubs, and ee trunks. Some of the more common ground pecies are *Eurhynchium oreganum*, *Hypnum rcinale*, *Rhytidiadelphus loreus*, *Mnium enziesii*, *Hylocomium splendens*, and *M. signe*. Among the abundant epiphytes are *seudisothecium stoloniferum*, *Porella navi-laris*, *Rhytidiadelphus loreus*, *Radula landeri*, *Frullania nisqualensis*, *Scapania landeri*, and *Ptilidium californicum*.

The Roosevelt elk (*Cervis canadensis roose-lti*) is the most important animal present. lk use the natural area as a wintering round. The relatively open, parklike nature most of the tract is a consequence of their tivity; their trails ease the problems of cess through the area. Undoubtedly, they ave also affected the composition of the nderstory vegetation (Sharpe 1956). Other ammals believed to utilize the area as sidents or transients are listed in table J-1.

Invertebrates recorded by Shelford (1963) uring a visit in 1945 included: millipedes *Iarpaphe haydeniana*), centipedes (*Arc-geophilus melanonotus* and *Otocryptops* .), spiders (*Hexura picea* and *Antrodiaetus geni*), numerous brown silverfish, camel ickets (*Pristoceuthophilus* sp.), ground etles (*Scaphinotus angusticollis velutinus*), ck beetles (*Ctenicera protracta*), Sitka mblebee (*Bombus sitkensis*), yellow jacket *espula arenaria*), the lavavorid fly (*Urso-yte migriceps*), and the boring beetle (*Pi-nia gnathoides*).

Streams and ...

HISTORY OF DISTURBANCE

There is evidence that fires burned o the area 200 or more years ago. Some f scars can be seen on old western redced and Douglas-fir. There is no indication more recent fires.

Human disturbance prior to establishme of the natural area is believed to have ha minor influence on natural conditions. one time an old pioneer road ran through area near the base of Quinault Ridge. Duri World War I the Spruce Production Divis built two short skidways into Section 31 a took out a few spruce trees. Finally, so dead cedar was utilized for fence posts.

There has been no disturbance since tablishment except for that associated w maintenance of U.S. Highway 101.

RESEARCH

A number of scientists have visited area in connection with zoologic, geolog botanic, and paleological studies of the Oly pic Peninsula but generally have not pu lished their observations with specific r erence to the natural area. One exception Dr. Victor E. Shelford whose observations invertebrate fauna (Shelford 1963) were cit earlier. The natural area has been visited part of two studies currently being made temperate forest communities on the Olym Peninsula.[2]

Special research opportunities which ex on the Quinault Research Natural Area i clude possibilities for studying (1) the effe of Roosevelt elk on their habitat and (2) t ecology of epiphytic mosses and lichens.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natur

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[2] Studies by Dr. R. W. Fonda, Biology Depa ment, Western Washington State College, Bellin ham, Washington and Mr. Edward Tisch, Biolo

ake, Washington quadrangle, scale 1:62,500, sued by the U.S. Geological Survey in 1955; nd *geology* — *Geologic Map of Washington*, ale 1:500,000 (Huntting et al. 1961). Either ne District Ranger (Quinault Ranger District) or Forest Supervisor (Olympic National orest, Olympia, Washington) can provide etails on the most recent aerial photo coverge and forest type maps for the area.

Records of the 1931 timber inventory and opies of the original forest type and topographic maps, prepared by Forest Service ersonnel, are on file at the Pacific Northwest 'orest and Range Experiment Station, Portand, Oregon.

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Shelford, Victor E.
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	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis roosevelti*	Roosevelt elk
	Odocoileus h. columbianus	black-tailed deer

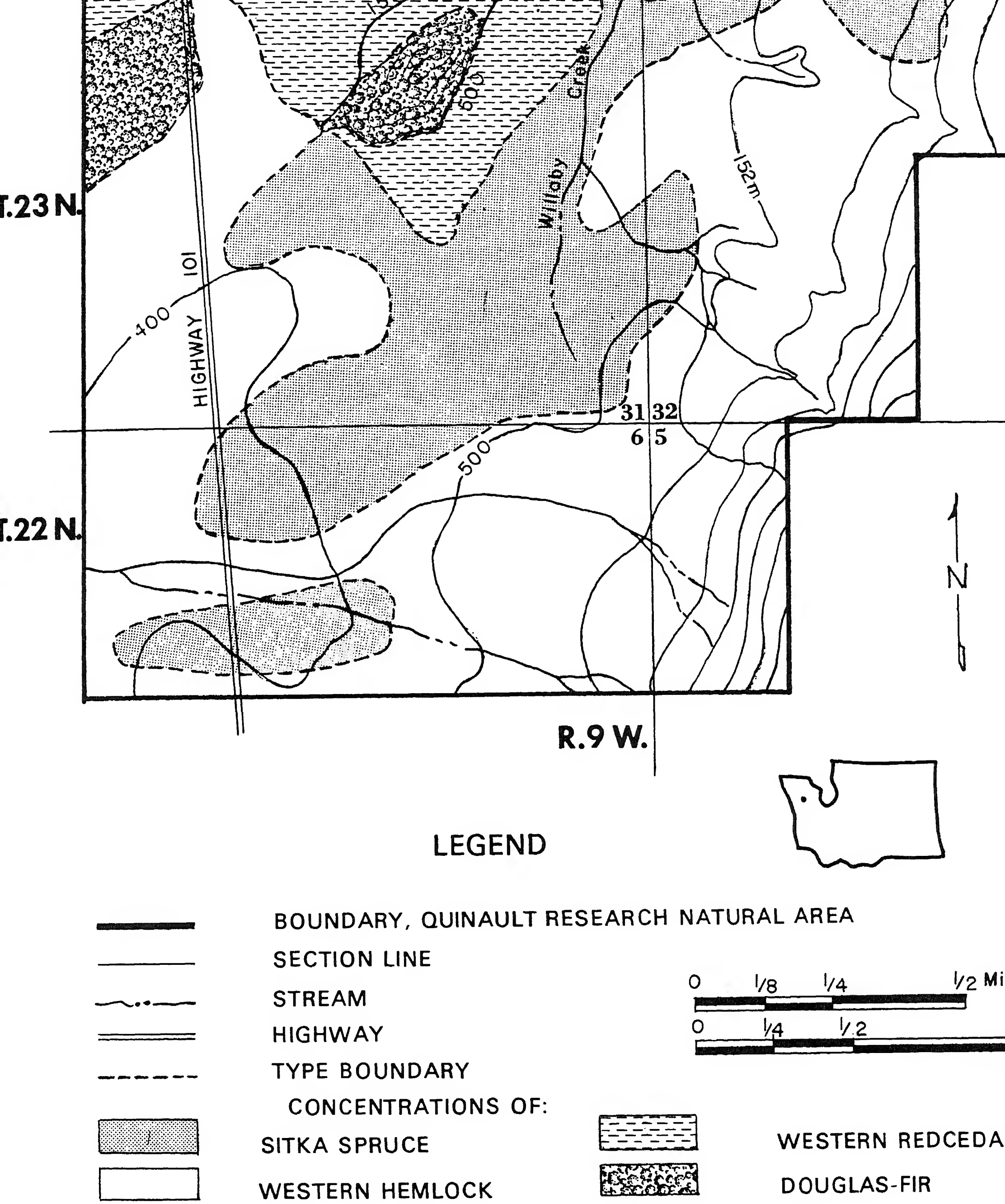

Figure QU-1.– **Quinault Research Natural Area, Grays Harbor C**
Washington, showing general area of tree species concen

Figure QU-2.—Communities of the Quinault Research Natural Area. Upper left: Old-growth specimen of western redcedar approximately 150-cm. d.b.h. growing in swampy area. Upper right: Open stand of western hemlock and Sitka spruce about 200 years in age showing dense reproduction of western hemlock. Lower left: Abundant reproduction of western hemlock and other species on typical rotting "nurse" log. Lower right: Mature specimen of Sitka spruce showing the log upon which it originally developed; typical dense understory of *Polystichum munitum* in the foreground.

RAINBOW CREEK RESEARCH NATURAL AREA[1]

Virgin grand fir-western white pine, Douglas-fir - ponderosa pine and western larch stands typical of the interior mixed-conifer forest zone in the northern Blue Mountains of southeastern Washington.

The Rainbow Creek Research Natural Area as established November 6, 1968. It exnplifies three forest types which are ecogically and commercially important in the orthern Blue Mountains of northeastern regon and southeastern Washington. The 70-ha. (420-acre) tract is located in Columbia ounty, Washington, and is administered by ie Pomeroy Ranger District (Pomeroy, 'ashington), Umatilla National Forest. Unnced, topographic boundaries give it an regular shape (fig. RC-1). It occupies porons of sections 14, 22, 23, and 26, T. 7 N., . 40 E., Willamette meridian. It lies at 7°15′ N. latitude and 117°50′ W. longitude.

CCESS AND CCOMMODATIONS

Access is rather difficult because the nearest oad terminates approximately 3 km. (2 miles) om the tract at Godman Guard Station. rail No. 3138 leads from Godman Guard tation to the edge of the natural area de-cending 480 m. (1,600 ft.) in elevation. pecific directions can be obtained from the omeroy District Ranger. Motorized vehicular traffic is prohibited on the trail by Regional Forester because the Rainbow search Natural Area lies entirely within designated Wanaha Back-Country Area. P lic accommodations are available in Dayt Washington, about 40 km. (25 miles) nor west. Primitive camps are located along Skyline Road, and there is a developed car ground at Godman Guard Station.

ENVIRONMENT

The Rainbow Creek Research Natural A varies from 1,100 m. (3,600 ft.) to a maxim of 1,440 m. (4,700 ft.) in elevation at summit of Sugarloaf Butte. The topograp varies from rolling to steep on the slopes the butte and all aspects are present (f RC-1 and RC-2).

The natural area is on an uplifted port of Columbia basalt flows with some volca ash deposits in the forested areas. Sugarl Butte represents a residual island in t deeply eroded and dissected area.

A modified continental climate preva with cool, moist, partly cloudy winters warm, dry, cloudless summers. Precipitat is moderate and seasonal, usually occurr as snow. The nearest climatic station (D ton, Washington) is 32 km. (20 miles) nor west of the tract on the Columbia Ba plateau and outside of the topographica modified climate; data from this station as follows (U.S. Weather Bureau 1965):

Mean annual temperature	10.5°C.	(50.9
Mean January temperature	−0.2°C.	(31.6
Mean July temperature	21.5°C.	(70.7
Mean January minimum temperature	−4.3°C.	(24.3
Mean July maximum temperature	30.6°C.	(87.2
Average annual precipitation	495 mm.	(19.5
June through August		

[1] Description prepared by Dr. F. C. Hall, U.S.

ense to dense forest cover. These soils are ommonly covered with a layer of aerially eposited volcanic ash and appear to fall in ne Umatilla and shallow, stony Umatilla ategories (Washington State Agricultural Experiment Station 1954). They may be roadly classed as Gray Wooded. Shrub and rassland soils tend to be shallow, stony Lithosols with little to moderate profile evelopment. These soils are located on upper portions of the butte, on ridge tops, and on teeper, colluvial areas.

BIOTA

Estimated areas by cover type are:

Name	*Area*
Grand fir-western white pine	57 ha. (140 acres)
Douglas-fir-ponderosa pine	93 ha. (230 acres)
Western larch	16 ha. (40 acres)
Grass and shrubs	4 ha. (10 acres)

The primary forest types of interest are the grand fir (*Abies grandis)* and western white pine (*Pinus monticola*) stands which are probably assignable to SAF forest cover type 213, Grand Fir-Larch-Douglas-Fir (Society of American Foresters 1954), and Küchler's (1964) Type 14, Grand Fir-Douglas Fir Forest. The Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) forests form an intricate intergrading mosaic and probably best fit SAF type 214, Ponderosa Pine-Larch-Douglas-Fir, or Küchler's Type 11, Western Ponderosa Forest, and Type 12, Douglas Fir Forest. The western larch (*Larix occidentalis*) stand is assignable to SAF type 212, Larch-Douglas-Fir, and is what Küchler considers seral to his Type 14, Grand Fir-Douglas Fir Forest. Grasslands are dominated by wheatgrasses (*Agropyron* spp.) and fall in Küchler's Type 51, Wheatgrass-Bluegrass. The entire area lies within the *Abies grandis* Zone of the Blue Mountains (Franklin and Dyrness 1969).

The grand fir-western white pine type (fig

cent of the total basal area (trees over 15-cr or 6-in. d.b.h.). Grand fir comprises 40 to percent of the basal area and Douglas- and western larch account for the rest. Grou vegetation is dominated by *Vaccinium me branacium*, along with Pacific yew (*Tax brevifolia*), thinleaf alder (*Alnus tenuifoli Rosa* spp., and 10 to 15 species of forbs a grasses. Tree reproduction is composed alm entirely of grand fir; western white p reproduction is nearly absent.

The Douglas-fir-ponderosa pine fore occur primarily on the south and west slo of Sugarloaf (fig. RC-1) where they are as ciated with small areas of grass and shr communities. The stand of pole-sized west larch (fig. RC-2) occurs on a northwest sl and represents natural forest success following catastrophic fire.

Rocky Mountain elk (*Cervus canaden* use the area extensively as summer ra The animals usually migrate down B Creek to winter along the Wanaha Ri Grass utilization by elk appears to be caus some change in the grassland communi and may be influencing reproduction Pacific yew within the forest stand. O mammals believed to utilize the tract as r dents or transients are listed in table R

HISTORY OF DISTURBANCE

Occasional fire-blackened snags and western larch stand indicate some histor catastrophic fires.

Domestic livestock, primarily sheep, gr the tract to some extent between 1890 about 1945 when they were removed. In past 20 to 30 years, elk numbers have creased significantly and presently ma altering some aspects of the nonforested communities.

Recreation use is rather high and inc ing. Grazing from pack and saddle might have some influence on bottom

egetation; (2) soil-vegetation relationships
nd factors responsible for the mosaic pattern
forest and nonforest communities; (3) natu-
l successional relationships of both western
hite pine and western larch; and (4) biomass
roduction as affected by soils and topography
nder a single macroclimate.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic maps re available for the natural area which are ufficiently detailed to be useful. Either the istrict Ranger (Pomeroy Ranger District) Forest Supervisor (Umatilla National orest, Pendleton, Oregon) can provide details the most recent aerial photo coverage of e area.

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	Sorex preblei	Preble shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis subulatus	small-footed myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
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	Sylvilagus nuttalli	mountain cottontail
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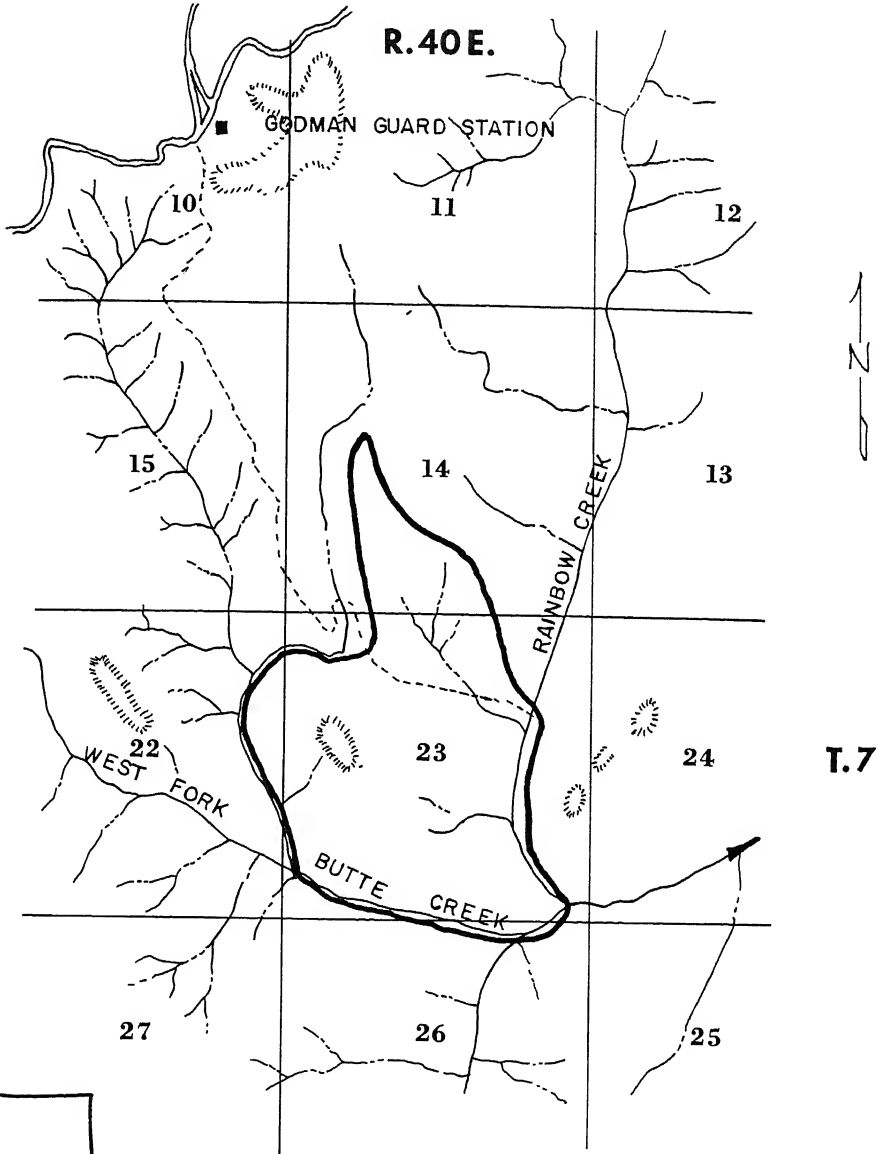
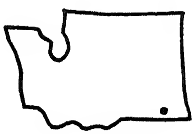
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus columbianus	Columbian ground squirrel
	Spermophilus lateralis	mantled ground squirrel
	Tamiasciurus hudsonicus	red squirrel
	Thomomys talpoides	northern pocket gopher
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer





LEGEND

BOUNDARY, RAINBOW CREEK RESEARCH NATURAL AREA

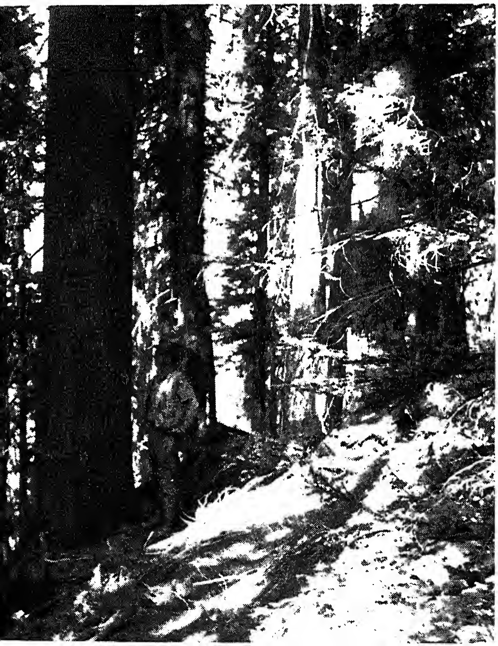
SECTION LINE

ROADS

0 1/4 1/2 1 Mi.

Figure RC-2.—Natural features of the Rainbow Creek Research Natural Area. Upper left: Aerial view of Sugarloaf Butte showing the southerly slope which has western white pine in the draws and on the lower slope (the two bottom photographs were taken in this area). Upper right: Aerial view of the northwest slope showing the stand of western larch and some bunchgrass openings. Lower left: Stand of grand fir and western white pine with some Douglas-fir on lower slope position; Pacific yew, *Vaccinium membranaceum, Rosa* spp., and forbs dominate the understory. Lower right: One of the largest western white pines; note clumped branches on the Pacific yew behind the pine caused by heavy browsing of elk in winter.






RATTLESNAKE HILLS RESEARCH NATURAL AREA[1 2]

Shrub-steppe vegetation (e.g., big sagebrush communities) in the arid interior of southeastern Washington.

The Rattlesnake Hills Research Natural rea was established to provide examples of ne shrub-steppe communities characteristic f the most arid portions of the Pacific Northvest. It is an island of natural vegetation urrounded by expanses of cultivated fields nder dryland or irrigated management egimes. The 33,350-ha. (75,000-acre) tract s located within the boundaries of the U.S. tomic Energy Commission's Hanford Works eservation in Benton County, Washington. esearch on the tract is managed for the tomic Energy Commission by the Battelle Iemorial Institute, Pacific Northwest Laboatories, Richland, Washington. The eastern oundary of the natural area is formed by tate Highway 240, while the western boundary follows the natural skyline of the Rattlenake Hills (fig. RH-1). It is located at 46°30′ I. latitude and 119°40′ W. longitude.

CCESS AND CCOMMODATIONS

The natural area is most easily reached via tate Highway 240 from Richland which is 4 km. (15 miles) to the south and east. There re numerous access roads which enter and raverse parts of the tract; these are marked ut are blocked by locked gates. Vehicular traffic is restricted to existing roads; off-r travel by vehicles is prohibited. Several ro are paved; to provide all-weather acces most of the natural area, some of the m troublesome unimproved routes have b stabilized with river gravel and crushed r

It is necessary to obtain permission to er the tract from the Pacific Northwest Labo tories' Arid Lands Ecology Project and Atomic Energy Commission's Richland Op ations Office. Inquiries for permission to the reserve should be directed to Dr. Bur E. Vaughn, Manager, Ecosystems Depa ment, Battelle-Northwest, Richland, Wa ington 99352. There are no restrictions photography within the natural area, firearms are not allowed unless needed perform research.

There are no living accommodations on natural area, but numerous facilities available in the nearby cities of Richla Pasco, Kennewick, and Benton City.

ENVIRONMENT

The Rattlesnake Hills Research Natu Area occupies the northeasterly facing slo of the Rattlesnake Hills, the southern tremity of Yakima Ridge, and interven gentle slopes and valleys. Elevations ra from 150 m. (500 ft.) on the valley floo 1,060 m. (3,500 ft.) along the crest of Rattlesnake Hills. The tract is underlain layers of Columbia River basalt of Mioc age but these are covered by eolian and a vial materials of variable thickness (Hunt et al. 1961).

The climate of the natural area can characterized as arid with hot summers cold winters. Most of the annual precipita occurs during the late fall and winter, snow a regular occurrence during wi

[1] Description prepared by Dr. W. H. Rickard, attelle Memorial Institute, Pacific Northwest Lab-

perature, precipitation, wind speed and direction, relative humidity, and solar radiation. Some average values are as follows:

Mean annual temperature	11.7°C. (53.1°F.)
Mean January temperature	−1.3°C. (29.6°F.)
Mean July temperature	20.4°C. (68.8°F.)
Mean January minimum temperature	−10.2°C. (13.7°F.)
Mean July maximum temperature	33.3°C. (91.7°F.)
Average annual precipitation	171.2 mm. (6.74 in.)
Average annual snowfall	32.0 cm. (12.6 in.)

Although the meteorological station yields relevant data, it is not representative of the climate of the entire natural area. A series of 25 stations have been located throughout the tract and since 1969 have provided data on precipitation and maximum and minimum air temperature (Hinds and Thorp 1959). These data are also available as monthly summaries. An automated microclimatological station has recently been established at 366-m. (1,200-ft.) elevation within the Grassland Biome study area.

Soils within the natural area have been mapped (Hajek 1966). Based on acreage, the Warden and Ritzville silt loams occupy most of the land area; they are found on the lower and middle slopes of the Rattlesnake Hills. Steep slopes, ridge crests, draw bottoms, and alluvial fans are mapped as Lickskillet, Kiona, and Scooteney silt loams. The basal plains are mapped as Esquatzel silt loam, Ephrata stony loam, Burbank sandy loam, and Hezel and Koehler sand. These series are classified by great soil group and according to the 7th Approximation in table RH-1.

The **Ritzville silt loam** series consist of dark colored soils midway up the slopes of the Rattlesnake Hills. They have developed under *Artemisia* and bunchgrasses from windlaid deposits which usually include small amounts of volcanic ash. The surface 2 dm. are usually a very dark grayish brown (10 YR 4/2) soil. Ritzville soils are usually more than 15 dm. deep, but bedrock may be en-

grayish brown in color (10 YR 4/2) subsoil is strongly calcareous at about The soil is usually more than 15 dm. **Kiona silt loams** are associated with Ri and Warden soils and occupy steep and ridges. The surface soil is very grayish brown (10 YR 3/2) and about thick. The dark brown (10 YR 4/3) s contains large basalt fragments 4 dm larger in diameter. **Lickskillet silt** occupy ridge tops above 765-m. (2,5 elevation in the Rattlesnake Hills. soils are shallow over basalt bedrock fragments of basalt present througho soil profile. This series is similar to the series except that the surface soils are (very dark brown, 10 YR 2/2). **Esq silt loams** are formed in recent alluviu color and texture of the subsoil var the stratified nature of the alluvial de Esquatzel soils are associated with R and Warden soils and often seem t developed from sediments eroded fron two series. **Scooteney stony silt loa** found on the northerly-facing slopes Rattlesnake Hills and are usually c to the bottoms of narrow draws a shaped areas where draws empty o the adjoining plain. These soils ar severely eroded with numerous outc basalt. The surface soil is usually dark (10 YR 4/2). **Ephrata sandy loa** associated with the Burbank soils. T face soil is very dark grayish brown 3/2), and the subsoil is dark grayish (10 YR 4/2). The medium textured soil is underlain by gravelly material meters in depth. **Burbank loamy sa** coarse-textured soils underlain by The surface soil averages about 4-dm but can have thicknesses of up to 7 d gravel content of the subsoil may ran 20 to 80 percent by volume. The surf is a very dark grayish brown (10 Y and the subsoil is dark grayish brown

eep, is very dark brown (10 YR 3/3) and was robably formed in wind-blown sand which nantled finer textured lacustrine sediments. he subsoil is a dark grayish brown (10 YR /2), sandy loam. **Koehler sands** are similar o other sandy soils but differ in that the and mantles a lime and silica cemented hardpan" layer. The surface soil is very ark grayish brown (10 YR 3/2) and the alcareous subsoil (10 YR 4/2) is encountered t about 5 dm.

Chemical characterizations of soils and ond sediments have been published (Wildung nd Hajek 1969, Wildung, Hajek, and Price 968). Selected data for the Ritzville and Varden series are provided in table RH-2.

BIOTA

Vegetation. — The Rattlesnake Hills Reearch Natural Area was selected as a natural rea primarily because of the presence of ndisturbed stands of several typical shrub teppe communities, although the vegetation nosaic also includes some disturbed plant ommunities. Of particular interest are the tands representative of the *Artemisia trientata/Agropyron spicatum*, *Artemisia ridentata/Poa secunda*, and *Eriogonum thyoides/Poa secunda* Associations described y Daubenmire (1970). However, some rare ut ecologically significant associations are lso present such as the *Eurotia lanata/ Poa secunda* type (Daubenmire 1970). Unisturbed or even lightly disturbed examples f the various shrub steppe communities found n the natural area are extremely difficult to nd elsewhere. Some of the communities inluded within the tract can be related to Küchler's (1964) Types 55, Sagebrush Steppe *Artemisia-Agropyron*), 40, Saltbush-Greaseood (*Atriplex-Sarcobatus*), and possibly 51, Vheatgrass-Bluegrass (*Agropyron-Festuca*). he natural area is located entirely within he *Artemisia tridentata/Agropyron spicaum* Zone, the most arid vegetative zone

the *Artemisia tridentata/Poa secunda* Asciation occurs below this elevation on ger slopes and on the plain. Both kinds of vegetion are subject to fire damage. When burns through a stand of the *Artemisia/Agpyron* or *Artemisia/Poa* Associations, shrubs are effectively killed but the und story grasses survive. There are a number stands dominated exclusively by bunchgras which have been created in this way; shr gradually reinvade these areas. Under gring stress, the perennial grasses are weened, and invasion by alien winter annu especially cheatgrass brome (*Bromus torum*) is prevalent (fig. RH-2).

The *Artemisia tridentata/Agropyron sptum* Association is dominated by big sabrush (*Artemisia tridentata*) and bluebu wheatgrass (*Agropyron spicatum*). Hops (*Grayia spinosa*) is sometimes present in shrub layer along with the low shrubs *Erigon filifolius* and *Phlox longifolia*. Big sabrush coverage varies from 5 to 26 perc in this association (Daubenmire 1970). Bl bunch wheatgrass is the major perenn grass with a typical coverage value of arou 50 percent. Sandberg bluegrass (*Poa secun* is always present with around 30-perc cover. Small amounts of *Stipa comata* *Poa cusickii* are also typical. Annuals usua present include cheatgrass brome, *Festoctoflora*, *F. pacifica*, *Descurainia filipes*, *Draba verna*.

The *Artemisia tridentata/Poa secunda* sociation lacks any large grasses and ha higher density of big sagebrush (Daubenm 1970). Big sagebrush coverage is typica around 35 percent. The only signific perennial grass is Sandberg bluegrass. V minor amounts of several annuals, such cheatgrass brome, *Descurainia*, and *Dra* are present. Stands typical of this associat typically have only half the indigenous t (five to ten on forty 20-cm. by 50-cm. pl that stands typifying the *Artemisia/Agro*

ss of the Rattlesnake Hills, basalt outps support vegetation characteristic of *Eriogonum thymoides/Poa secunda* Assotion (fig. RH-2). Here low growing plants *Eriogonum thymoides, Phlox hoodii, Hapappus stenophyllus*, and *Balsamorhiza ea* and Sandberg bluegrass grow widely ced as clumps rooted in the rock crevices. gure RH-2 includes a closeup photograph *Lewisia rediviva*, one of the plants found these lithosolic habitats. At the crest of Rattlesnake Hills snow accumulates in p drifts on the eastern slopes as it is transted by strong westerly winds. The melting w provides soil moisture which is exploited plants not found elsewhere on the reserve. pecially conspicuous are *Lupinus* spp. . RH-2) and a perennial bunchgrass, Idaho cue (*Festuca idahoensis*).

Permanent springs are scarce on the reve. Two of the most copious are located at ttlesnake Springs and in Snively Gulch. e extent of the riparian vegetation in vely Gulch is illustrated in fig. RH-2. The portant species are black cottonwood (*Pops trichocarpa*), *Salix exigua*, as well other *Salix* species, *Prunus americana*, *us glabra*, and *Philadelphus lewisii*. Although riparian communities occupy only a acres, they are an extremely important ting habitat for birds. The springs also vide drinking water for numerous birds mammals and support an aquatic fauna.

lthough big sagebrush and, sometimes, sage are the common shrub dominants r most of the natural area, there are eral thousand acres on the lower slopes of Rattlesnake Hills occupied by winter- (*Eurotia lanata*) dominated communities . RH-2). The factors that tend to keep ebrush from growing on these sites are known. There are also about 40 ha. (100 es) of land near Rattlesnake Springs which port greasewood (*Sarcobatus vermicula-*. Greasewood is confined to the area where

lationships of halophytes (Rickard and Cline 1965, Rickard 1965a, Rickard 1965b, Rickard 1967b, and Rickard and Keough 1968), the influence of microclimate on the growth of winter annuals (Hinds and Rickard 1968, Rickard, Hinds, and Gilbert 1971) and the composition of the plant communities (Daubenmire 1970). Radionuclides have proved useful in obtaining data on the root distribution of big sagebrush (Price 1965).

Current studies in plant ecology are concerned with measuring primary production of winter annuals on abandoned cultivated fields at different elevations in relation to climatic and edaphic variables, especially soil moisture, temperature, and nitrogen. Estimates of aboveground productivity have been made over the past several years. The results of harvests of two old fields at different elevations of the natural area at the time of peak yield in 1971 are shown below; results are expressed as grams of ovendry material per square meter of ground ± the standard error of the mean for total material:

Taxa	Elevation	
	300 m. (1,000 ft.)	515 m. (1,700 ft.)
Bromus tectorum	198	233
Poa secunda	1	0
Sisymbrium altissimum	10	6
Amsinckia lycopsoides	2	0
Descurainia pinnata	0	1
Tragopogon dubius	0	14
Microseris laciniata	0	2
Holosteum umbellatum	0	7
Total live material	211 ± 11	263 ± 38

The dominant plant on both fields is clearly cheatgrass — 94 and 88 percent of the total production on the low elevation and high elevation fields, respectively. After 28 years of abandonment, native plants still have made little progress in colonizing these old field habitats. Old fields also appear more productive than pristine stands of vegetation; for example, total live material produced

tridgus thibautii), chukar (*Alectoris graeca*), ring-necked pheasant (*Phasianus colchicus*), sage grouse (*Centrocercus urophasianus*), California quail (*Lophortyx californicus*), and mourning dove (*Zenaidura macroura*). Only the chukar and dove exist in populations of sufficient size to support even limited hunting pressure.

The fur-bearing animals are the coyote (*Canis latrans*), badger (*Taxidea taxus*), and bobcat (*Lynx rufus*). The population levels of these animals are unknown but badgers are probably more scarce than coyotes; the bobcat is rarely seen on the natural area.

The most abundant small mammal in the reserve is the Great Basin pocket mouse (*Perognathus parvus*) (fig. RH-2). This mammal has been intensively studied by Dr. T. P. O'Farrell by mark-recapture technique in several vegetation types on the natural area. A study of the distribution of small mammals in relation to the elevational gradient in the Rattlesnake Hills has been carried out by Kritzman (1970). Other small mammals that occur on the project are deer mouse (*Peromyscus maniculatus*), northern grasshopper mouse (*Onychomys leucogaster*), western harvest mouse (*Reithrodontomys megalotis*), Townsend ground squirrel (*Citellus townsendii*), vagrant shrew (*Sorex vagrans*), sagebrush vole (*Lagurus curtatus*), and northern pocket gopher (*Thomomys talpoides*). Blacktail jackrabbits (*Lepus californicus*) occur on the natural area but mostly at low elevations, and the least chipmunk (*Eutamias minimus*) occurs only at high elevations.

The most abundant breeding birds in steppe vegetation at low elevations are the horned lark (*Eremophila alpestris*) and western meadowlark (*Sturnella neglecta*). There are fewer individuals of the sage sparrow (*Amphispiza belli*), sage thrasher (*Oreoscoptes montanus*), and loggerhead shrike (*Lanius ludovicianus*). At higher elevations the vesper sparrow (*Pooecetes gramineus*) and Brewer's sparrow (*Spizella breweri*) are important

warblers (*Parulidae*), and vireos (*Vireo* s

The riparian tree-shrub communities vide breeding sites for the black-billed ma (*Pica pica*), western and eastern king (*Tyrannus verticalis* and *T. tyrannus*), l bunting (*Passerina amoena*), red-sh flicker (*Colaptes cafer*), and starling (*Stu vulgaris*). Killdeer (*Charadrius vocif* and long-billed curlew (*Numenius amer us*) nests have been found in the vicini Rattlesnake Springs. A survey of bird pop tions in riparian plant communities in w has been reported for the Yakima River plain near Richland (Rickard 1964).

Birds of prey nest on the natural especially the sparrow hawk (*Falco spar us*), Swainson's hawk (*Buteo swainsoni*), horned owl (*Bubo virginianus*), marsh h (*Circus cyaneus*), and burrowing owl (*Sp to cunicularia*). The golden eagle (*A chrysaetos*) is a frequent winter visitor.

Little is known about the dynamics o populations of reptiles on the natural Some information is available concerning altitudinal distribution of the side-blot lizard (*Uta stansburiana*) (Rickard 196 well as the time of onset of winter dorm (Rickard 1967). Other reptiles observe the natural area are the Pacific rattles (*Crotalus viridis*), gopher snake (*Pitu melanoleucus*), yellow-bellied racer (*Col constrictor*), and the short-horned li (*Phrynosoma douglassi*).

The invertebrate fauna of the natural have received little attention. A taxon survey of foliage dwelling insects has under way for several years by Dr. W Cone of Washington State University date several hundred species of insects been identified and related to various p species on the tract. The ground-dwe beetles have been investigated to some ex (Hakonson and Rickard 1969, Rickard Haverfield 1965, Rickard 1968, Rickard 1 Rickard 1970b, and Rickard 1971). autumn emergent darkling beetles (S

son, autumn emergent beetles were esti-
ed to provide 20 kg. of live biomass per
are.

STORY OF DISTURBANCE

he grazing history of the natural area r to 1943 is not documented. However, l ranchers recall sheep and cattle grazing he Rattlesnake Hills prior to that time. grazing has been allowed since 1943, and area is now fenced in its entirety to ude wandering livestock. The condition of various plant communities and abundance everal highly palatable forage plants such winterfat (*Eurotia*) and hopsage (*Grayia*) gest that whatever grazing took place probably been a minor disturbing in nce. Water was probably a seriously limit factor in utilization of the tract by estic stock.

ome portions of the natural area were farmed prior to Federal acquisition of tract in 1943. The communities on these ndoned fields are undergoing natural suc ion and are being utilized in comparative ies with the natural vegetation.

ost recent human disturbance has re- d from off-road military vehicle use ng war games in 1965. These left numer track scars on part of the landscape. er present management, human disturb is minimal and existing roadways are roved in lieu of new road construction.

ire has been and continues to be an ortant natural disturbance. An extensive fire occurred in the summer of 1957 and mostly confined to the *Artemisia-Agro-* *n* association at elevations above 300 m. 00 ft.).

SEARCH

eld research on the Rattlesnake Hills

... are utilizing the tract. Sixteen hecta (40 acres) of the natural area are presen designated and under study as the ALE (A Lands Ecology) coordinating site in the Int national Biological Program's Grassla Biome project.

Much of the ongoing research has be cited earlier in this description of the natu area; included is research in climatology a micrometeorology, plant ecology (both au ecology and synecology), animal ecolo hydrology, and soil science. Some speci studies involve: productivity and mine relationships of plants in abandoned cultiva fields and in pristine plant communiti studies of small mammal populations und various plant community manipulations, su as treatment with selected herbicides a addition of moisture using controlled sprin ler irrigation; and hydrologic and mine nutrient relationships in a phreatophy community.

Research facilities are concentrated three laboratory sites on the natural ar These are: a small 20- by 40-foot me building located at Rattlesnake Springs; building complex located at the 360-m. (1,2 ft.) level at the southern end of the reserv and another building complex located at t crest of the Rattlesnake Hills, also near t southern edge of the reserve. The first t facilities are primarily utilized in biologi research, and the last named is an astronon cal facility.

MAPS AND AERIAL PHOTOGRAPHS

U.S. Geological Survey topographic ma are available for the entire natural are scientists should consult the U.S. Geologi Survey's index to topographic maps in Was ington to determine the quadrangle(s) specific interest to them. The geology of t

special maps.

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Ritzville silt loam	Brown Integrade to Regosol	Andic Aridic Haplustoll
Warden silt loam	Sierozem Integrade to Regesol	Andic Mollic Camborthid
Kiona silt loam	Sierozem Integrade to Regesol	Andic Mollic Camborthid
Lickskillet silt loam	Lithosol	Lithic Haplustoll
Scooteney stony silt loam	Sierozem Integrade to Regosol	Andic Mollic Camborthid
Ephrata stony loam	Sierozem Integrade to Regosol	Mollandeptic Camborthid
Burbank loamy sand	Regosol	Typic Torripsamment
Hezel sand	Regosol	Typic Torrifluvent
Koehler sand	Regosol	Mollic Durothid

Table RH-2. — Selected chemical properties of the Warden (Wa) and Ritzville (Ri) soi series within the Rattlesnake Hills Research Natural Area

Sample depth	pH		Organic matter		Calcium		Potassium		Tota exchang base
(decimeters)	Wa	Ri	Wa	Ri	Wa	Ri	Wa	Ri	Wa
			Percent		..........Pounds per acre..........				me./10
0 - 1	7.1	6.9	1.3	1.4	3,100	2,200	1,210	1,300	12.3
1 - 2	7.3	7.1	.6	.9	2,700	2,500	780	1,190	11.4
2 - 3	7.3	7.3	.5	1.0	3,200	2,600	410	1,100	12.1
3 - 4	7.2	7.3	.5	.7	3,200	2,400	300	980	12.2
5 - 6	7.4	7.4	.5	.9	3,400	3,100	160	800	12.8
7 - 8	7.3	7.5	.3	.7	3,100	3,200	120	700	11.7
9 - 10	7.5	7.7	.3	.5	3,400	2,700	160	540	12.8

RATTLESNAKE HILLS RESEARCH NATURAL AREA

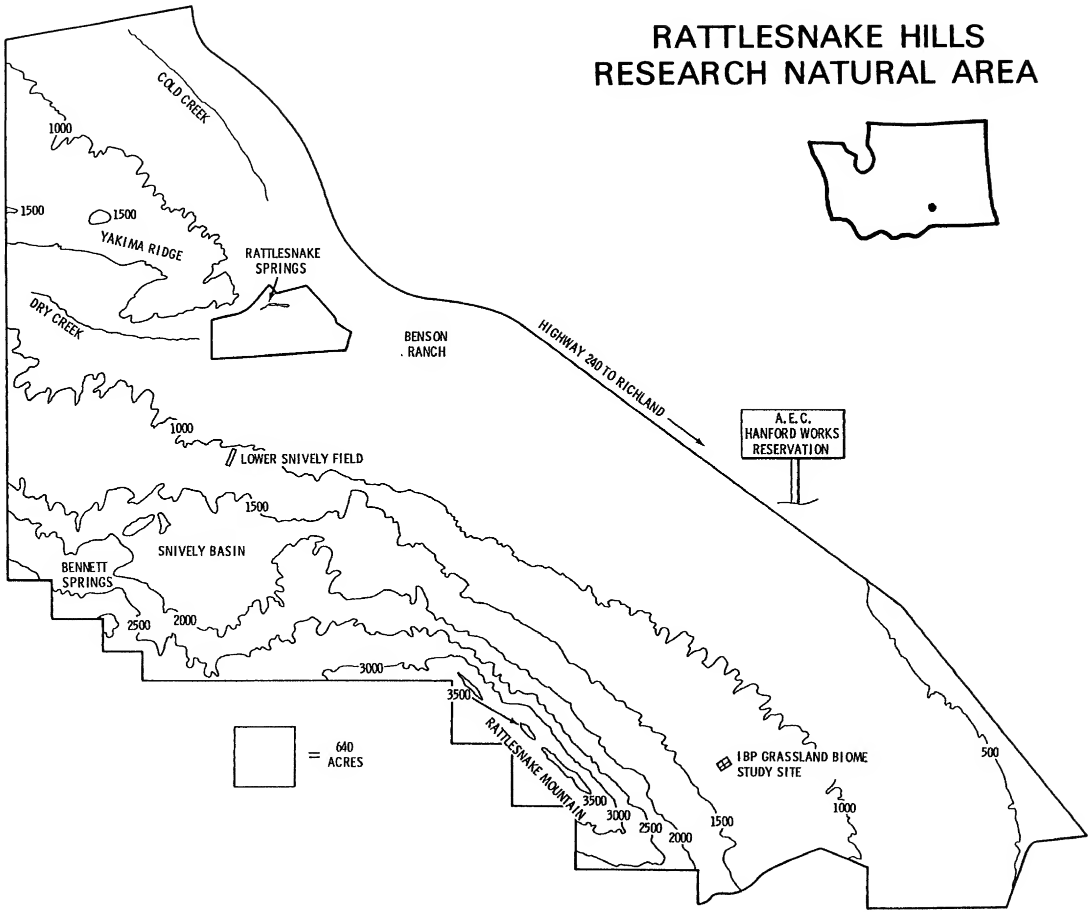

Figure RH-2.—Natural features of Rattlesnake Hills Research Natural Area. (All photos courtesy of Dr. T. P. O'Farrell, Battelle Northwest.) A: Pristine community representative of the *Artemisia tridentata/Agropyron spicatum* Association which is typical of higher elevations; note the Rattlesnake Hills in the background. B: Community dominated by big sagebrush and hopsage typical of those found on the basal plain; the understory is composed of cheatgrass brome, an alien annual grass which is highly successful on habitats disturbed by grazing.


22

Figure RH-2.—Natural features of Rattlesnake Hills Research Natural Area (continued). C: Winterfat forms islandlike stands which are surrounded by communities of big sagebrush on the lower slopes of the Rattlesnake Hills. D: The most extensive stand of deciduous shrubs and trees which is found along a spring-fed brook below Snively Basin.

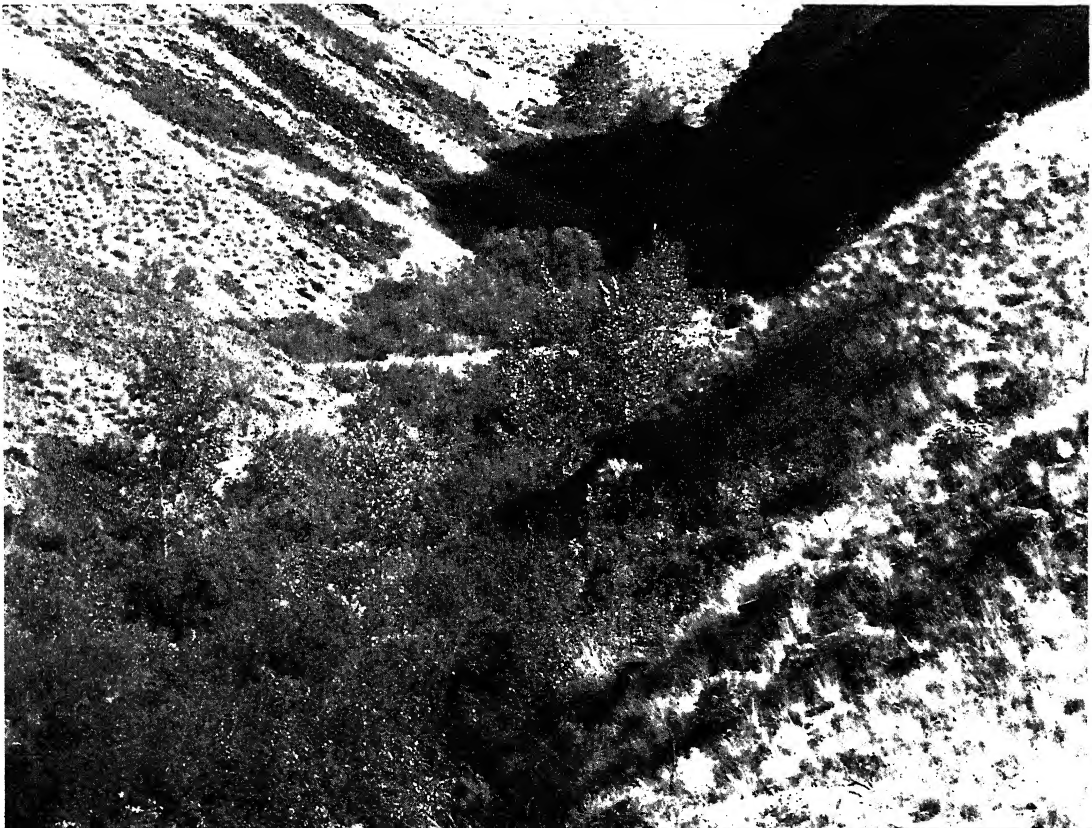

Figure RH-2.—Natural features of Rattlesnake Hills Research Natural Area (continued). E: Lithosolic communities inhabit stony outcrops in the Rattlesnake Hills; typical species illustrated here are *Balsamorhiza rosea* and Sandberg bluegrass. F: *Lewisia rediviva,* another conspicuous plant on lithosolic sites in the Rattlesnake Hills. G: *Lupinus* providing a conspicuous display of color following snow melt; snowdrifts persist late into the spring on northeast-facing slopes at the crest of the Rattlesnake Hills. H: The most abundant mammal on the natural area, the Great Basin pocket mouse (*Perognathus parvus*).

E

F

G

H

SISTER ROCKS RESEARCH NATURAL AREA[1]

Pacific silver fir stands on a mountain ridgetop of Eocene-Oligocene volcanics in the Washington Cascade Range.

The Sister Rocks Research Natural Area as established on September 5, 1967. It emplifies Pacific silver fir (*Abies amabilis*) ands as they occur on mountain slopes and dgetops in older (Eocene-Oligocene) volnic portions of the Cascade Range. The 87-. (215-acre) tract is located in Skamania ounty, Washington, and is administered by e Wind River Ranger District (Carson, ashington), Gifford Pinchot National Fort. The tract occupies portions of sections 3, 10, and 11, T. 5 N., R. 6 E., Willamette eridian (fig. SR-1), based upon natural atures and locations of Roads N63 (on the est) and N63J (proposed, on the north). It s at 45°56′ N. latitude and 122°03′ W. ngitude.

CCESS AND CCOMMODATIONS

Access to the vicinity is easiest from the uth via the Columbia River (U.S. Highway 0), Carson, and the Wind River valley (For- Roads 30, N73, N64, and N63); it can so be approached from the west via Amboy d Forest Roads N56, N54, and N58. Forest ail 155 begins at the northern point of the tural area and extends its entire length (fig. SR-1). The trail provides access to c tral and southern portions of the tract a bounding roads (existing and planned) to remainder. At present, eastern portions least accessible.

The nearest commercial accommodati are in Stevenson, Washington, about 40 k (25 miles) away, or occasionally, in Coug However, there are several improved for camps in the adjacent Wind River valley.

ENVIRONMENT

The Sister Rocks Research Natural A occupies a broad, north-trending ridget Slopes are generally gentle to moderate (to 30-percent) except along the lower marg of the area where steeper (60- to 80-perce slopes occur. Elevations range from ab 1,100 to 1,280 m. (3,600 to 4,200 ft.).

Geologically, the natural area is simp Underlying bedrock is composed of Eoce Oligocene volcanics, predominantly andesi in character (Huntting et al. 1961). Incluc within the overburden are elements of vario Pleistocene and/or Recent volcanic ash a pumice falls, some of the ejecta formi distinct layers.

The climate is wet and cold. Precipitati is seasonal, peaking during winter mon and reaching low levels during the summ period. Much of the winter precipitati occurs as snow and accumulates in snowpa which proabaly attain maximum depths 2 to 3 m. (70 to 120 in.) based on a near snowcourse at Oldman Pass (U.S. Soil Co servation Service n.d.). The following clima data are from the Wind River weather stati which is about 19 km. (12 miles) southeast and 600 m. (2,000 ft.) below the natural a (U.S. Weather Bureau 1965):

Mean annual temperature .... 8.7°C. (47.8°

[1] Description prepared by Dr. J. F. Franklin, U.S. partment of Agriculture, Forest Service, Pacific

ipitation .... 119 mm. (4.67 in.)

peratures are undoubtedly considerably and precipitation somewhat higher on atural area.

ls in the natural area are generally lic with distinctive A2-B2 sequences; have not been mapped or classified into s, however. A typical profile from the r of the tract had the following horizon nce: 01 and 02, 6 to 0 cm.; A2, 0 to 3 IIA1b, 3 to 6 cm.; IIB2b, 6 to 11 cm.; IB3b, 11 cm. plus. The A2 has developed ount St. Helens "W" pumice which is 450 years in age (Crandell 1969); the d profile was developed from andesite coria.[2]

TA

87 ha. (215 acres) of the Sister Rocks arch Natural Area are classified as SAF type 226, Pacific Silver Fir-Hemlock ety of American Foresters 1954). The falls within Küchler's (1964) Types 33 (Silver Fir-Douglas Fir or Fir-Hemlock st) and the *Abies amabilis* Zone of klin and Dyrness (1969).

acific silver fir dominates the natural , frequently occurring in pure stands SR-2). Western hemlock (*Tsuga hetero-la*) is the most common associate (fig. 2). Douglas-fir (*Pseudotsuga menziesii*) early absent at higher elevations but mes occasional to common in some lower e stands; on local type maps, there are a. (59 acres) on which Douglas-fir is a or component. Noble fir (*Abies procera*) so scattered through the area, and the ence of snags and stumps of this species gests it was once more common. Noble mountain hemlock (*Tsuga mertensiana*), lodgepole pine (*Pinus contorta*) occur

wildfire in 1902 (fig. SR-2).

Pacific silver firs in the natural area are typically 65- to 100-cm. (25- to 40-in.) d.b.h. and 36 to 43 m. (120 to 140 ft.) tall. Stem analyses of similar Pacific silver firs growing nearby suggest a wide range of ages, with 250 to 350 years most common.[3]

Pacific silver fir is clearly the climax tree species throughout the natural area, based upon size class distributions and reproductive success. Consequently, pure, uneven-aged Pacific silver fir stands are the hypothetical climax here, and much of the area already approximates this structure and composition. Douglas-fir and noble fir occur only as large, old individuals; in many areas, they are present as dead or dying specimens or as stumps and down logs. The relatively tolerant western hemlock is likewise failing to reproduce in significant numbers and is primarily represented by old, overmature specimens.

Based upon Franklin's (1966) classification of the subalpine forests in this part of the Cascade Range, there are three major community types within the natural area: The *Abies amabilis/Streptopus curvipes (Erythronium montanum* phase) and *Abies amabilis/Vaccinium alaskaense* Associations, and an *Abies procera/Xerophyllum tenax* community. The *Abies amabilis/Streptopus curvipes* Association is most common in the central portion of the natural area. This community has well-developed shrub and herb layers. *Vaccinium ovalifolium*, *V. alaskaense*, *V. membranaceum*, and *Menziesia ferruginea* are the dominant shrubs. The abundant herbs include *Tiarella unifoliata*, *Rubus pedatus*, *R. lasiococcus*, *Clintonia uniflora*, *Erythronium montanum*, *Streptopus curvipes*, and *Cornus canadensis*. *Rhytidiopsis robusta*, *Brachythecium velutinum*, and *Dicranum*

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[2] Unpublished data provided by Dr. H. W. Smith, nomy Department, Washington State Univer-

[3] Unpublished data provided by Mr. F. R. Herman and on file at U.S. Forest Service, Forestry Sciences

ervosa, Xerophyllum tenax, Chimaphila nbellata, and *Rhytidiopsis robusta* are com-on constituents. The *Abies procera/Xero-hyllum tenax* community is a pioneer type hich characterizes the small area of 50-year-d burn found at the southern margin of the atural area. *Xerophyllum tenax* and *Vac-nium membranaceum* are the most abun-ant understory plants.

Mammals believed to utilize the natural ea as residents or transients are listed in ble SR-1.

ISTORY OF DISTURBANCE

Road construction has caused, and will ntinue to cause, some disturbance along the argins of the natural area and, in connection th clearcutting of adjacent lands, will pro-ice some edge effects. However, most of the ea is free of human disturbance except for e trail. The trail is used occasionally by kers, berry pickers, and hunters. There is evidence that wildfires have occurred with- the natural area for several centuries out-de of the strip of 1902 burn which was in-uded to provide a contrast with the old-owth stands.

and for a study of characteristics and d tribution of Recent pumice and ash falls.[4]

This natural area is particularly valua as a site for studies of the ecology of Pac silver fir, offering a variety of stand ty and conditions, including pure stands an recently burned area.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natu area include: *Topography*—15' Lookout Mo tain, Washington quadrangle, scale 1:62,5 issued by the U.S. Geological Survey in 19 and *geology—Geologic Map of Washingt* scale 1:500,000 (Huntting et al. 1961). Eit the District Ranger (Wind River Ran District) or Forest Supervisor (Gifford P chot National Forest, Vancouver, Washi ton) can provide details on the most rec aerial photo coverage and forest type m for the area.

[4] Research by Dr. H. W. Smith, Agronomy Dep ment, Washington State University, Pullman.

U.S. Geol. Surv. Bull. 1292, 43 p., illus.

klin, Jerry F., and C. T. Dyrness
69. Vegetation of Oregon and Washington. USDA Forest Serv. Res. Pap. PNW-80, 216 p., illus. Pac. Northwest Forest & Range Exp. Stn., Portland, Oreg.

klin, Jerry Forest
66. Vegetation and soils in the subalpine forests of the southern Washington Cascade Range. 132 p., illus. (Ph.D. thesis, on file at Wash. State Univ., Pullman.)

ting, Marshall T., W. A. G. Bennett, ghan E. Livingston, Jr., and Wayne S. n
61. Geologic map of Washington. Wash.

potential natural vegetation of the conterminous United States. Am. Geogr. Soc. Spec. Publ. 36, various paging, illus.

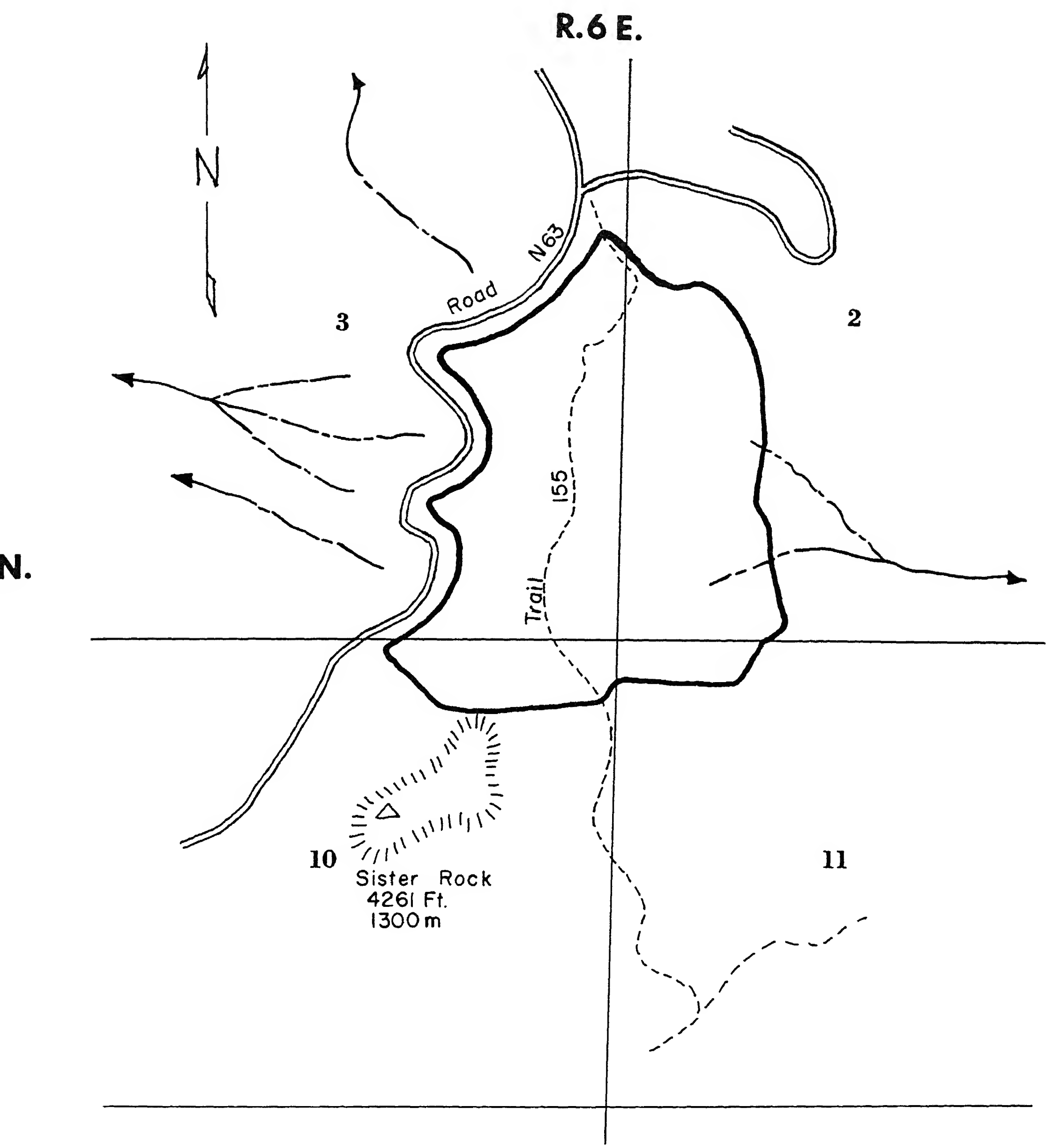
Society of American Foresters
1954. Forest cover types of North America (exclusive of Mexico). 67 p., illus. Washington, D.C.

U.S. Soil Conservation Service
n.d. Summary of snow survey measurements for Washington 1915-1969. Various paging, illus. USDA Soil Conserv. Serv. and Wash. Dep. Ecol.

U.S. Weather Bureau
1965. Climatic summary of the United States—supplement for 1951 through 1960, Washington. Climatography of the United States 86-39, 92 p., illus.

Table SR-1. Tentative list of mammals for Sister Rocks Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus saturatus	Cascades mantled ground s
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket gopher
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or erm
	Mustela frenata	long-tailed weasel
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer



LEGEND

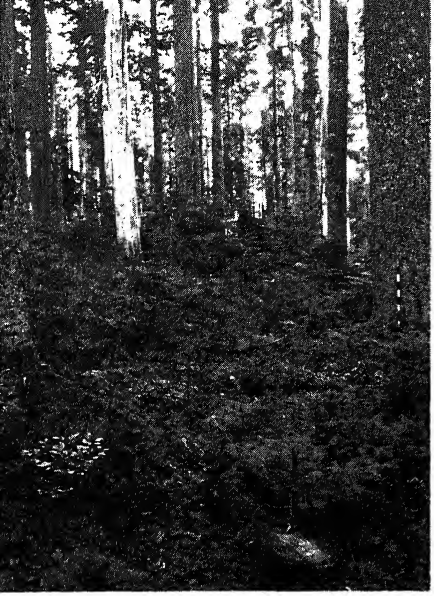
BOUNDARY, SISTER ROCKS RESEARCH NATURAL AREA

SECTION LINE

STREAM

0 1/8 1/4 1/2 Mi.

Figure SR-2.—Communities of the Sister Rocks Research Natural Area. Upper left: Pure stand of Pacific silver fir with dense reproduction 0.5 to 1 m. tall. Upper right: Mixed stand of Pacific silver fir and western hemlock, the latter represented only by large, overmature specimens. Lower left: Noble fir/*Xerophyllum tenax* community growing on area burned by wildfire in 1902 and located at the southern edge of the natural area. Lower right: Mixed stand of Pacific silver fir, Douglas-fir, and western hemlock with abundant seedlings, saplings, and poles of Pacific silver fir.




TURNBULL PINE RESEARCH NATURAL AREA[1]

Ponderosa pine/bunchgrass savanna and pothole lakes and ponds characteristic of east central Washington.

The Turnbull Pine Research Natural Area .s established December 1966 to exemplify arly pristine ponderosa pine (*Pinus pon- rosa*) savanna at the transition from forest grassland and a series of freewater potholes aracteristic of the Channeled Scablands und on the basalt plateau of east-central ashington. The 81-ha. (200-acre) tract is cated in Spokane County, Washington, and administered by the Turnbull National ildlife Refuge (Route 3, Box 107, Cheney, ashington), Bureau of Sport Fisheries and ildlife. The irregularly shaped tract is cated in section 25, T. 21 N., R. 43 E., illamette meridian, at 47°27′ N. latitude d 117°30′ W. longitude (fig. TP-1).

CCESS AND CCOMMODATIONS

The natural area is located 2.5 km. (1.5 les) south of Cheney, Washington, along e Cheney-Plaza County road which forms e tract's west boundary. Access is excellent ring the summer and generally good during e winter. Public accommodations are avail- le at Cheney.

NVIRONMENT

The Turnbull Pine Research Natural Area ranges from 685 to 715 m. (2,250 to 2,350 ft in elevation. Topography is generally und lating to rolling except around the potho lakes which are often surrounded by ste slopes or rock cliffs (fig. TP-2).

The natural area is located on easte Washington's well-known Channeled Sca lands (Bretz 1959). The Columbia Riv basalts which characterize the entire Colu bia Plateau provide the foundation of th landscape. An intricate network of draina channels are carved into this bedrock and overburden of loess. Glacial damming of t Columbia River by a lobe of the continent ice sheet is believed to have combined wi successive massive floods released from g cially dammed lakes to produce the scablan The natural area itself was probably nev actually glaciated.

A modified maritime climate prevai Most precipitation occurs as rain or sn during the cool, cloudy winter. Summers a warm, generally low in precipitation, a largely cloudless. One to 3 months of droug are common. Climatic data from Spoka about 29 km. (18 miles) north, are as follo (U.S. Weather Bureau 1965):

Mean annual temperature	8.8°C. (47.8°
Mean January temperature	−3.7°C. (25.3°
Mean July temperature	21.4°C. (70.5°
Mean January minimum temperature	−7.7°C. (18.1°
Mean July maximum temperature	28.7°C. (83.7°
Average annual precipitation	437 mm. (17.2
June through August precipitation	56 mm. (2.2
Average annual snowfall	147 cm. (58.0

Soils in the area were mapped someti between 1955 and 1961, and complete inf mation is found in the Spokane County S Survey (Donaldson and Giese 1968). Hess tine soils are predominant on the area w the major portion mapped as Hesseltine v

[1] Description prepared by Dr. F. C. Hall, U.S.

upland soil with topsoil down to 4 dm. in.) deep, underlain by coarse gravel and es to a depth of up to 15 dm. (60 in.) over alt bedrock. Minor areas of other Hessel-type soils also occur. The Hesseltine soils typically forested. Soils in the meadows around pothole borders are the Cocollala clay loam. This soil ranges up to 14 dm. in.) deep and is formed in volcanic ash osits mixed with silty alluvium. Highly anic Semiahmoo muck soils are found the potholes (e.g., in fig. TP-2), which ggests natural pond succession and rophication.

OTA

stimated areas by vegetation type are ollows:

Name	*Area*
derosa pine forest	65 ha. (160 acres)
ssland	8 ha. (20 acres)
king aspen	4 ha. (10 acres)
atic (kettle lakes and potholes)	4 ha. (10 acres)

he forest stands are assignable to SAF est cover type 237, Interior Ponderosa e (Society of American Foresters 1954), Küchler's (1964) Type 11, Western Ponosa Forest. The grasslands best fit Küchs Type 51, Wheatgrass-Bluegrass with ne Type 50, Fescue-Wheatgrass. The kettle es and potholes with their associated mea-vegetation would probably fit Küchler's pe 49, Tule Marshes. The natural area s in a zone of ponderosa pine savanna ere ponderosa forests gradually grade into umbia Basin bunchgrass.

Ponderosa pine (*Pinus ponderosa*) forests y be divided into two community types: *us ponderosa/Festuca idahoensis* and *us ponderosa/Symphoricarpos albus/Calagrostis rubescens*. The *Pinus/Festuca* e is characteristic of convex topography l shallower soils. Pine crown cover varies

cristata, *Potentilla glandulosa*, and *Erigeron* spp. (see fig. PN-2 in Pine Creek Research Natural Area description). They appear related to Daubenmire and Daubenmire's (1968) *Pinus ponderosa/Festuca idahoensis* Association.

The *Pinus/Symphoricarpos/Calamagrostis* community type is characteristic of lower concave microtopography and small swale bottoms (fig. TP-2). Pine crown cover varies from 35 to 50 percent. Ground vegetation is codominated by *Symphoricarpos albus* and pinegrass (*Calamagrostis rubescens*). Other important components are Idaho fescue, elk sedge (*Carex geyeri*), and *Fragaria virginiana* var. *platypetala*. This community does not clearly fit any of Daubenmire and Daubenmire's (1968) associations. It is probably a variant of their *Pinus ponderosa/Symphoricarpos albus* Association in which pinegrass is far more important than their classification recognizes. Variations in microtopography and soil depth seem related to these two forest communities.

Quaking aspen (*Populus tremuloides*) communities occasionally occur in small meadows (fig. TP-2) and as stringers around lakes and meadows. Quaking aspen is clearly dominant. Associated vegetation is *Symphoricarpos albus*, *Solidago* spp., thinleaf alder (*Alnus tenuifolia*), water birch (*Betula occidentalis*), and *Cornus stolonifera*.

The grasslands generally occur on convex surfaces of the gentle, undulating topography and appear associated with shallow soils (fig. TP-2). Other than very occasional ponderosa pine, they are dominated by bluebunch wheatgrass, Idaho fescue, and *Bromus* spp. on deeper soils. On shallower soils they are dominated by Sandberg bluegrass and *Bromus* spp. with some Idaho fescue and bluebunch wheatgrass.

The 4 ha. (10 acres) of kettle and pothole lakes are characterized by freewater ponds which retain their water all season long and

g... ...lysepalus) often colonizes free-water areas. ...onds are often edged by wet meadows characterized by tule (*Scirpus accutus* and/or *S. validus*) with occasional colonies of cattails (*Typha latifolia*). Where moisture and free water are less abundant, the tule grades into moist meadow dominated by *Phalaris arundinacea*, which is often associated with *Deschampsia caespitosa*. Most pothole lakes are surrounded by rock ledges or steep slopes from 10 to 25 feet high (fig. TP-2).

Mammals believed to utilize the natural area as residents or transients are listed in table TP-1. A list of resident and transitory birds can be obtained from the Refuge Manager.

HISTORY OF DISTURBANCE

Fire scars on ponderosa pine indicate ground fires periodically burned the area prior to fire control programs.

RESEARCH

Some research is being conducted by ecology students at nearby Eastern Washington State College, Cheney, Washington. Information may be obtained from the Refuge Manager or from the Biology Department of Eastern Washington State College. Voucher specimens of some birds and animals and most plant species are available for inspection at Refuge Headquarters.

The natural area provides unique opportunities to study: (1) the ecology of pothole lakes and their associated meadow vegetation ...sed conditions; (2) interac... between dry upland nonforested vegetati... and forested vegetation on slopes and betwe... forest and meadow and meadow and fr... water; (3) relationships of faunal spec... distribution to vegetation over these extrem... ly variable environmental conditions; a... (4) aquatic communities.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic ma... are available for the natural area which a... sufficiently detailed to be useful. The Refu... Manager (Turnbull National Wildlife Refu... Cheney, Washington) can provide details ... the most recent aerial photo coverage ... the area.

Since refuge establishment in 1937, grazi... tree cutting, and other disturbances ha... been prohibited on the original 20 ha. (... acres) of this natural area (the northweste... corner of the present tract). The natural ar... was expanded to 81 ha. (200 acres) in 19... and the 61-ha. (150-acre) addition had ... ceived some light use by cattle each ye... between 1937 and 1968. The old-growth po... derosa pine was logged prior to Refuge ... tablishment, and present forest stands a... sapling and pole sized with occasional larg... trees. Domestic livestock also used the ar... sometimes heavily, prior to Refuge establis... ment. The abundance of *Bromus* spp. sugge... livestock overuse produced some modificati... of ground vegetation.

Bull. 45, 57 p., illus.

enmire, R., and Jean B. Daubenmire
68. Forest vegetation of eastern Washington and northern Idaho. Wash. Agric. Exp. Stn. Tech. Bull. 60, 104 p., illus.

ldson, N. C., and L. D. Giese
68. Soil survey of Spokane County, Washington. USDA Soil Conserv. Serv. & Wash. Agric. Exp. Stn., 143 p., illus.

Geogr. Soc. Spec. Publ. 36, various paging, illus.

Society of American Foresters
1954. Forest cover types of North America (exclusive of Mexico). 67 p., illus. Washington, D.C.

U.S. Weather Bureau
1965. Climatic summary of the United States—supplement for 1951 through 1960, Washington. Climatography of the United States 86-39, 92 p., illus.

Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis lucifugus	little brown myotis
	Myotis subulatus	small-footed myotis
	Myotis yumanensis	Yuma myotis
	Pipistrellus hesperus	western pipistrel
	Plecotus townsendi	Townsend big-eared b
Lagomorpha	*Lepus californicus*	black-tailed jack rabb
	Sylvilagus nuttalli	mountain cottontail
Rodentia	*Erethizon dorsatum*	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Glaucomys sabrinus	northern flying squirr
	Marmota flaviventris	yellow-bellied marmo
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus pennsylvanicus	meadow vole
	Neotoma cinerea	bushy-tailed wood rat
	Ondatra zibethicus	muskrat
	Onychomys leucogaster	northern grasshopper
	Perognathus parvus	Great Basin pocket m
	Peromyscus maniculatus	deer mouse
	Reithrodontomys megalotis	western harvest mous
	Spermophilus columbianus	Columbian ground squ
	Tamiasciurus hudsonicus	red squirrel
	Thomomys talpoides	northern pocket gophe
Carnivora	*Canis latrans*	coyote
	Lynx rufus	bobcat
	Mephitis mephitis	striped skunk
	Mustela frenata	long-tailed weasel
	Taxidea taxus	badger
Artiodactyla	*Odocoileus h. hemionus*	mule deer
	Odocoileus virgianus	white-tailed deer

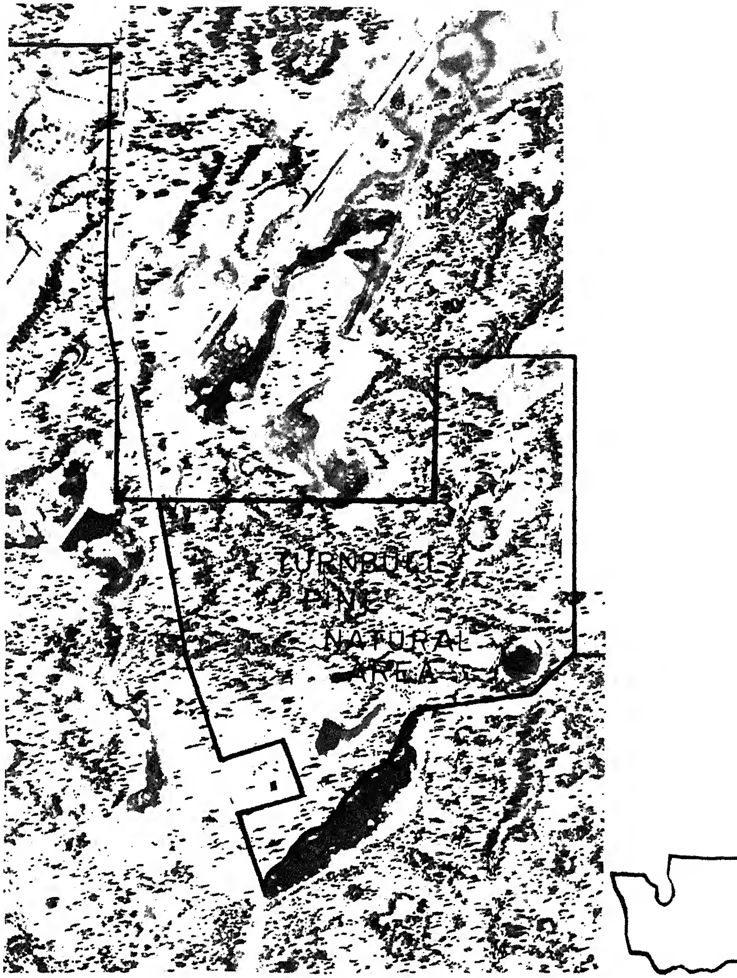
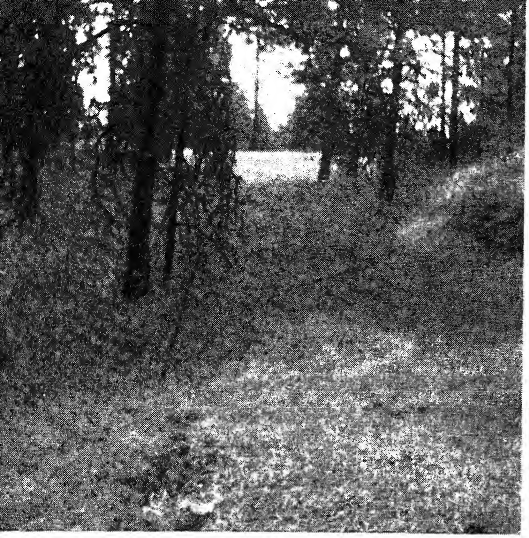


Figure TP-1.– Turnbull Pine Research Natural A
Spokane County, Washington.

Figure TP-2.—Natural features of the Turnbull Pine Research Natural Area. Upper left: Common forest community of ponderosa pine, *Symphoricarpos albus,* and pinegrass with some Idaho fescue and elk sedge. Upper right: Dry meadow of *Agrostis alba* and *Phleum pratense* and quaking aspen meadow with *Symphoricarpos, Solidago,* and thinleaf alder. Lower left: Common community on top of gentle "biscuits," *Bromus* spp. on shallow soil. Lower right: Free water pond and adjacent tule meadow; rock rim around the pond is typical.




TWIN CREEK RESEARCH NATURAL AREA[1]

"Rain forest" Sitka spruce-western hemlock stands growing on terraces along the Hoh River on the western Olympic Peninsula, Washington.

The Twin Creek Research Natural Area as established in 1958 to exemplify Sitka pruce (*Picea sitchensis*) forests as they occur nder the "rain forest" conditions found in ver valleys on the west side of the Olympic eninsula. The 40-ha. (100-acre) tract is cated in Jefferson County, Washington, and administered by Olympic National Park Port Angeles, Washington). The natural rea is located in two units which occupy ortions of sections 20, 21, and 29, T. 27 N., . 10 W., Willamette meridian. Legal lines rovide the boundaries. The tract is located t 47°50′ N. latitude and 124°00′ W. longitude.

CCESS AND CCOMMODATIONS

The natural area is located a short distance om the Hoh River Road, about 23 km. (14 iles) from its junction with U.S. Highway 01. The west unit is located about 1.6 km. 1 mile) inside the park boundary and 9 km. 5.5 miles) from the visitors center at the nd of the Hoh River Road. The east unit is cated about 1.6 km. (1 mile) east of the west nit. There are no trails within the natural rea, but cross-country travel is not too ifficult because of the gentle topography.

Commercial accommodations are available n Forks or Kalaloch, along U.S. Highway 101, from 40 to 56 km. (25 to 35 miles) aw However, there is an excellent public ca ground at the end of the Hoh River Road several smaller State campgrounds al the road outside the park.

ENVIRONMENT

The natural area occupies gentle topogra on river terraces in the Hoh River val Elevations range from about 130 to 195 (420 to 640 ft.) in the west unit and 150 to m. (500 to 580 ft.) in the east unit. T branches of Twin Creek flow through a p tion of the east unit and swampy areas found in both units of the natural area (TW-1).

The natural area is located on up Cretaceous-lower Tertiary sedimentary ro belonging to the Soleduck formation (Dan 1955, Huntting et al. 1961); however, b rock is completely buried beneath depositi of alluvium and possibly some glacial d The valley of the Hoh River, including natural area, has been glaciated at le three times during the Wisconsin age and least once in pre-Wisconsin time (Cran 1964).

A wet, mild, maritime climate preva Winters are mild and summers are cool w frequent cloudy days. Precipitation is hea but less than 10 percent falls during sum months. The following climatic data are fr the Forks weather station located appr mately 32 km. (20 miles) northwest of natural area (U.S. Weather Bureau 1965):

Mean annual temperature	9.55°C. (49.2
Mean January temperature	3.72°C. (38.7
Mean July temperature	15.39°C. (59.7
Mean January minimum temperature	0.17°C. (32.3
Mean July maximum temperature	21.55°C. (70.8
Average annual precipitation	2,974 mm. (117.10
June through August precipitation	214 mm. (8.44

[1] Description prepared by Dr. J. F. Franklin, U.S. epartment of Agriculture, Forest Service, Pacific orthwest Forest and Range Experiment Station,

on similar terrace areas in the vicinity of the natural area and found the following sequence to be typical:

02	2 to 0 cm.	Fresh litter.
A1	0 to 16 cm.	Very dark grayish brown with moderate crumb structure.
B1	16 to 46 cm.	Very dark gray sand, compact breaking to single grain.
B2	46 to 57 cm.	Very dark gray sand with single grain to weak crumb structure and some clay accumulation.
C1	57 to 150 cm.	Black sands with single grain structure.
IIC2	150 cm.+	River cobbles and gravels.

BIOTA

Essentially all the forest within the natural area can be considered a mixture of SAF forest cover types 225, Sitka Spruce-Western Hemlock, and 223, Sitka Spruce, with the latter type probably dominant (Society of American Foresters 1954). They belong to Küchler's (1964) Type 1, Spruce-Cedar-Hemlock Forest. The tracts are located within the *Picea sitchensis* Zone of Franklin and Dyrness (1969). Categorizing the area in this fashion does not do it justice, however; it is a fine example of the so-called "Olympic Rain Forest" found on major river terraces on the west side of the Olympic Peninsula (Kirk 1966).

The two units are mosaics of Sitka spruce and western hemlock (*Tsuga heterophylla*) forest of varying ages and sizes interspersed with open areas dominated by vine maple (*Acer circinatum*) and occasionally bigleaf maple (*Acer macrophyllum*). Sitka spruce and western hemlock make up about 80 and 20 percent of the stand volume, respectively. Both the spruce and hemlock are present in

[2] Personal communication from Dr. Richard W. Fonda, Department of Biology, Western Washington State College, Bellingham.

leaf maple and Douglas-fir (*Pseudot menziesii*) occur in more localized portio the natural area. Bigleaf maple typi obtains diameters of 75 to 100 cm. (30 t in.) b.h. and heights of 15 to 21 m. (50 t ft.). Douglas-fir is largely confined to steep terrace faces found towards the n edge of both of the units.

The forests in the natural area appear near climax condition. Although Sitka sp is considered a subclimax species in the *P sitchensis* Zone of Franklin and Dyr (1969), this does not appear to be the ca this area. Spruce seedlings and saplings small poles are encountered throughout of the area. Climax status is probably a pa consequence of the special conditions foun "rain forest" valleys of the western Oly Peninsula, particularly the relatively nature of many of the stands and sele grazing of hemlock seedlings by elk.[3] tree reproduction is found on rotting "nurse logs," which often support hunc of hemlock and spruce seedlings. Som these survive, and their roots reach mi soil. The consequences are visible throug the natural area as lines of mature growing on remains of original nurse and in the stilted root systems of many c spruce and hemlock.

Forest stands have relatively rich and developed understories. Vine maple, *ciinium ovalifolium*, *V. parvifolium*, *R ursinus*, and *R. spectabilis* are the most mon species in the shrub layer. Vine ma clearly the most important. Relative spa of *Rubus spectabilis* compared to many coastal forest stands may be a consequ of grazing by elk. The major herba species are *Oxalis oregana*, *Polystic munitum*, *Tiarella unifoliata*, *Carex de ana*, *Trisetum cernuum*, *Maianthemun folium* var. *kamschaticum*, *Rubus ped Montia sibirica*, *Athyrium filix-femina*,

[3] See footnote 2.

xception. Mosses, liverworts, and lichens lanket the ground, downed logs, shrubs, and ree trunks. Some of the more common round species are *Eurhynchium oreganum*, *ypnum circinale*, *Rhytidiadelphus loreus*, *Inium menziesii*, *Hylocomium splendens*, nd *Mnium insigne*. One of the most conpicuous epiphytes is the club moss, *Selaginel- serpens*, which is particularly abundant n the maples. Other common epiphytes are *seudoisothecium stoloniferum*, *Porella navilaris*, *Rhytidiadelphus loreus*, *Radula bonderi*, *Frullania nisqualensis*, *Scapania olanderi*, and *Ptilidium californicum*.

The Roosevelt elk (*Cervis canadensis rooseelti*) is the most important animal present. lk use the natural area most heavily during he winter and spring. Other mammals beeved to utilize the area as residents or ransients are listed in table TW-1.

Twin Creek provides some area of aquatic abitat in the east unit of the natural area. s mentioned, both units contain open wampy area, providing additional specialized abitat for a variety of plants and animals ot typical of heavily forested areas. These wampy areas have standing water for at east a portion of the year.

HISTORY OF DISTURBANCE

Human disturbance appears to be very inor despite the proximity of the area to the Ioh River Road. There is no evidence of ildfires within the tract within the last everal centuries.

connection with a study of relationsh between forest communities and environmtal conditions in the Hoh River Valley.[4]

The natural area appears to offer unusua good opportunities for research on: (1) scessional development in coastal fore particularly the relative successional potions of Sitka spruce and western hemlock typical second-terrace rain forest conditi (2) effect of Roosevelt elk on community coposition and forest succession; and (3) ecology of epiphytic mosses, club mos liverworts, and lichens.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural include: *Topography*—15′ Spruce Moun and Mount Tom, Washington quadrang scale 1:62,500, issued by the U.S. Geolog Survey in 1956 (Spruce Mountain quadran covers the west unit and Mount Tom qu rangle the east unit of the natural area) Topographic Map of Olympic National and Vicinity, Washington, scale 1:125, issued by the U.S. Geological Survey in 1 and *geology—Geologic Map of Washing* scale 1:500,000 (Huntting et al. 1961). Superintendent, Olympic National Park (Angeles, Washington), can provide detail the most recent aerial photo coverage forest type maps for the area.

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[4] Research by Dr. R. W. Fonda, Departmen Biology, Western Washington State College, ingham.

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	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or err
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet ca
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis roosevelti*	Roosevelt elk
	Odocoileus h. columbianus	black-tailed deer

LEGEND

BOUNDARY, TWIN CREEK RESEARCH NATURAL AREA

SECTION LINE

STREAM

SWAMP

16	15
21	22

SECTION CORNER (T.27., R. 10 W., W.M.)

SITKA SPRUCE - WESTERN HEMLOCK FOREST

1 DOUGLAS-FIR - SITKA SPRUCE - WESTERN HEMLOCK FOREST

2 OPEN AREA

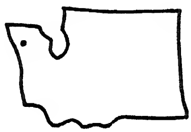
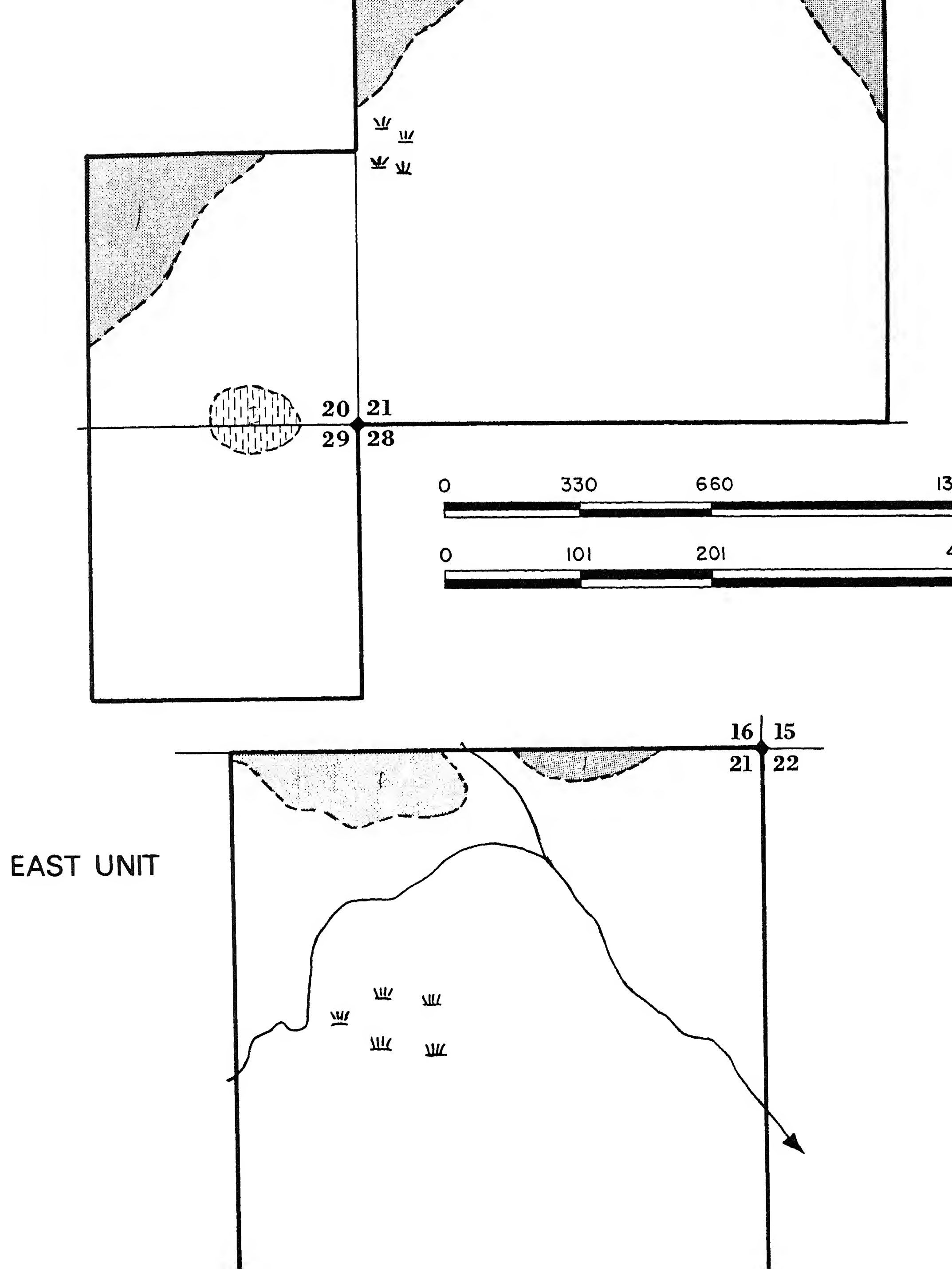


Figure TW-1.– Twin Creek Research Natural Area, Jefferson County, Washington.



20
21
29
28
0
330
660
13
0
101
201
16
15
21
22
EAST UNIT

Figure TW-2.—Typical forest community of bigleaf maple Sitka spruce, and vine maple found within portions o the Twin Creek Research Natural Area; note the abun dance of epiphytes on the maples.

WILDCAT MOUNTAIN RESEARCH NATURAL AREA[1]

Stands of noble fir and associated species on mountain slopes and ridgetops in the western Cascade Range of Oregon.

The Wildcat Mountain Research Natural rea was established on March 18, 1968, to eserve prime examples of noble fir (*Abies ocera*) stands as they occur on mountain dges in the western Cascades of Oregon. The 05-ha. (1,000-acre) tract is located in Linn ounty, Oregon, and is administered by the cKenzie Bridge Ranger District (McKenzie ridge, Oregon), Willamette National For-t. The tract occupies portions of sections 7, 20, 21, 22, 27, and 28, T. 14 S., R. 6 E., Villamette meridian (fig. WM-1). The south-rn boundary is marked by Forest Road 147 nd the dividing ridge between Browder and unchgrass Creeks (fig. WM-1). The northern oundary is based on various natural features sed either directly or as control points. It es at 44°20′ N. latitude and 122°06′ W. ngitude.

CCESS AND CCOMMODATIONS

It is easiest to approach the vicinity from ther the north (Albany and Sweet Home), sing U.S. Highway 20, or from the south Eugene) using U.S. Highway 126. From .S. Highway 20, turn south just west of Tombstone Summit onto Forest Road 134 and follow it to Forest Road 147 and th natural area. From U.S. Highway 126, tur north onto Forest Road 1645 (about 14 kr or 9 miles east of McKenzie Bridge Rang Station). The natural area can be reached v this and Forest Road 1345 or via Forest Ro 147 which leaves Forest Road 1645 about 2 km. (1.5 miles) north of U.S. Highway 126.

Forest Road 147 provides access to most the southern edge of the natural area, and th abandoned Wildcat Mountain trail travers the western half, terminating at the summ of the mountain.

ENVIRONMENT

The Wildcat Mountain Research Natur Area extends across the summit ridge Wildcat Mountain onto the north slope Bunchgrass Mountain (fig. WM-1). Elev tions range from about 1,160 m. (3,800 ft.) the bottom of a drainage in section 22 1,632 m. (5,353 ft.) at the summit of Wildc Mountain. Several distinctive topograph units can be recognized: (1) the southwe face of Wildcat Mountain which has modera (20- to 40-percent) slopes at its base and creasingly steeper (50- to 70-percent) g dients near the summit; (2) the north fa of Wildcat Mountain which is largely ste or precipitous (50- to over 100-percent slop and has frequent rock outcrops; and (3) t drainages on the north slope of Bunchgr Mountain and associated ridges which ha steep (30 to 80 percent) but generally precipitous slopes.

The natural area lies within a geologica older (Eocene to Miocene) part of the Casca Range known as the western Cascades. current geologic map indicates the tract located on "volcanic rocks of the High C cade Range" which were intruded in Pliocene and Pleistocene, i.e., the format

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[1] Description prepared by Dr. J. F. Franklin and r. C. T. Dyrness, U.S. Department of Agriculture, orest Service, Pacific Northwest Forest and Range xperiment Station, Forestry Sciences Laboratory, orvallis, Oregon.

associated in time or in place of origin ith High Cascade volcanism." (Taylor 1968). opographically the natural area is certainly nsistent with the deeply eroded character the western Cascades, and it lies several lometers west of the recognized boundary pproximately the McKenzie River) between e western and high Cascades.

The dominant rock type is andesite. Volanic tuffs, breccias, and possibly, intrusive lugs and dikes also occur in the area. Peck al. (1964) have provided some data on the thology and petrography of the volcanic edrock. Residual materials are covered with eolian deposits of volcanic ash except where e ash has been removed by erosion. The ource and age of the ash deposits are unnown, but there are many possible vents in djacent parts of the high Cascades (Taylor 968).

The wet, cool climate of the natural area is ypical of subalpine areas in the Cascade ange. Precipitation is heaviest during the inter months (November through March); nly 4 to 5 percent occurs during the summer June through August). About half of the recipitation occurs as snow and accumulates n winter snowpacks which reach maximum epths of 2 to 3 m. (70 to 120 in.) between February and March. The peak of snowmelt ypically occurs in May and is completed by une or early July. There are no nearby climatic stations which provide useful climatic ndices for the natural area. However, headuarters of the U.S. Army Corps of Engineers' Willamette Basin Snow Laboratory was loated in the pass between Squaw and Wildcat Mountains, about 1 km. (0.5 mile) west of the atural area. Between 1947 and 1951, this aboratory collected data on general climate, snow hydrology, streamflow, etc., in the Blue River drainage. The following data are average values computed for this drainage (U.S. Army Corps of Engineers North Pacific Division 1956):

Snowfall (water equivalent) . . . . . 174 cm. (68.5 i

Since the mean elevation for the basin und study is 1,045 m. (3,430 ft.), temperatures a lower on the natural area and precipitation higher; an isohyetal map suggests 3,810 4,065 mm. (150 to 160 in.) of annual preci tation on the natural area (U.S. Army Cor of Engineers North Pacific Division 195 The numerous data collected at the Willame Basin Snow Laboratory are summarized "Snow Hydrology: Summary Report of t Snow Investigations" (U.S. Army Corps Engineers North Pacific Division 1956) a are on file at the division office in Portla Oregon.

Soils in the area are poorly developed Bro Podzolics. In some locations it is difficult discern any profile development. General however, the surface 15 to 30 cm. (6 to 12 i of soil is a weakly expressed B2ir hori comprised of dark brown, very friable lo or sandy loam with weak subangular blo structure. This soil material can be describ as "fluffy" and is always of very low b density. Soil texture usually shows little va ation throughout the profile. Stone cont increases with depth and often reaches 50 60 percent by volume at 45 to 60 cm. (17 to 23.62 in.). Despite abundant andesite fr ments in the profile these soils are apparen largely derived from aeolian deposits of canic ash. Forest floor thickness ranges fr 4 to 8 cm. (1.5 to 3 in.) and is occasiona underlain by a very thin, discontinuous horizon.

BIOTA

Approximately 288 ha. (710 acres) of Wildcat Mountain Research Natural A are forested. A detailed breakdown of area by National Forest inventory type, S cover type (Society of American Forest 1954), composition, and age class is provi

(noble fir-dominated)

26	Pacific Silver Fir-Hemlock (Pacific silver fir-dominated)	38 ha. (95 acres)
05	Mountain Hemlock-Subalpine Fir	22 ha. (55 acres)
30	Douglas-Fir-Western Hemlock	17 ha. (43 acres)

here are 117 ha. (289 acres) of nonforested nds within the natural area, which include cky cliffs, meadows of various types, and ushfields (fig. WM-2). Küchler (1964) types presented include Silver Fir-Douglas Fir orest (3) and Fir-Hemlock Forest (4). Most the natural area lies within the *Abies nabilis* Zone; the *Tsuga mertensiana* Zone represented at higher elevations (Franklin nd Dyrness 1969).

The most important and nearly ubiquitous ee species in the natural area is noble fir. ure, 130-year-old stands located in the southestern quarter and 300-year-old stands in e eastern third of the natural area provide xcellent examples of this species. Pacific lver fir (*Abies amabilis*), Douglas-fir (*Pseuotsuga menziesii*), and mountain hemlock *Tsuga mertensiana*) are common associates. acific silver fir is absent from the overstory some of the pure noble fir stands but is resent everywhere as seedlings and saplings; a few stands at highest elevations Pacific lver fir and mountain hemlock are the only pecies present. Douglas-fir is most abundant the drainage in section 22 and is nearly osent at higher elevations. Some of the 130-ear-old stands contain residual 450-year-old ouglas-fir specimens which survived the estruction of the previous stand; young, 30-year-old Douglas-firs in such stands are

[2] Assignment of some forest stands in this area to AF cover types was, in part, arbitrary due to inadequacies in the type definitions (Society of American Foresters 1954). Mixtures of Pacific silver fir nd mountain hemlock were assigned to types 226 r 205 based on the relative importance of the two pecies. All areas dominated by noble fir or a mixture f Douglas-fir and noble fir were assigned to type 226.

tensis), and western hemlock (*Tsuga hetero-phylla*). The pine is scattered throughout th area, but much of it is presently dead or dyin from attacks by bark beetles and white pin blister rust. Alaska-cedar is generally foun on rocky habitats along the ridgetops an around some meadow areas. Western hem lock is essentially confined to lower elevation

Mensurational data have been collecte only from the younger forest stands in th natural area. Dominant noble fir in the highl productive southwestern part of the natur area average 75- to 100-cm. (30- to 40-in d.b.h. and 50 to 55 m. (160 to 180 ft.) tal Ring counts on roadside stumps indicate range in age from 120 to 137 years; these da substantiate the age class recognized in th 1960 inventory. Douglas-fir of the same a in these stands average 15 to 30 cm. (6 to in.) smaller in diameter and 2 to 5 m. (5 15 ft.) shorter than the dominant noble fir The scattered old-growth Douglas-firs a commonly 125- to 150-cm. (50- to 60-in d.b.h. and about 450 years old. Domina Pacific silver fir and mountain hemlock stan growing on poorer sites average 30- to 60-c (12- to 24-in.) d.b.h. and 30 to 35 m. (100 120 ft.) tall at 120 to 130 years. Trees fou in stands over 130 years of age are, of cour larger in size, given comparable site con tions. Maximum diameters observed to da are 186.7 cm. (73.5 in.) at b.h. for noble and 91.4 cm. (36.0 in.) b.h. for Pacific silv fir.

Based on size class distributions, succ sional trends apparently favor gradual placement of most forest tree species Pacific silver fir. The degree to which succ sional processes have advanced varies great especially with stand age, but the trend compositional changes is generally clear. F example, Pacific silver fir seedlings and s lings are abundant in many of the you (130-year-old), pure noble fir stands; there are relatively few specimens of

ose of mountain hemlock in mixed stands these species. In general, noble fir is failing reproduce within closed forest stands; owever, seedlings are abundant on the forest oor after a good seed year and may persist r several years before dying. Mountain emlock and Douglas-fir also appear ineffctual in reproducing themselves in forest ands.

At least four major forest communities can e recognized within the natural area based n the limited sampling thus far: *Abies procera/Clintonia uniflora, Abies procera/Achlys triphylla, Tsuga mertensiana - Abies amabilis/Xerophyllum tenax*, and *Abies amabilis/Vaccinium membranaceum - Xerophyllum tenax*.[3]

The *Abies procera/Clintonia uniflora* community is found on productive, relatively mesic sites. It is characterized by a herb-rich nderstory which averages 40- to 45-percent anopy coverage; in some dense stands the overage is much less (fig. WM-3). Typical pecies include *Achlys triphylla, Anemone deltoidea, Chimaphila menziesii, C. umbellata, Clintonia uniflora, Cornus canadensis, Galium oreganum, Pyrola picta, P. secunda, Pteridium aquilinum, Rubus lasiococcus, Smilacina sessilifolia, Tiarella unifoliata, Viola glabella*, and *V. sempervirens*. *Cornus, Smilacina*, and *Clintonia* usually have the highest coverage of herbaceous species. *Vaccinium membranaceum* has high constancy, but its coverage is relatively low (1 to 15 percent).

Abies procera/Achlys triphylla communities are found on somewhat poorer sites, e.g., areas of shallower soil. Vine maple (*Acer circinatum*) is usually a conspicuous shrubby element in stands of this type. *Vaccinium*

[3] These are vegetation units which have been recognized in a classification of forest communities in the western Cascades of Oregon. Details are available from Dr. C. T. Dyrness, U.S. Forest Service, Forestry Sciences Laboratory, Corvallis, Oregon.

oreganum, Viola glabella, and *V. sempervirens*. The *Achlys* and *Smilacina* norma have the highest herbaceous coverage.

The *Tsuga mertensiana-Abies amabil Xerophyllum tenax* community is typical the poorest forested habitats, i.e., sites w the shortest, coolest growing seasons a shallow soils. Only two species are importa in the understory — *Xerophyllum ten* and *Vaccinium membranaceum*. The lil ceous *Xerophyllum* completely domina with canopy coverage of up to 90 perc (fig. WM-3).

A fourth forest community, the *Ab amabilis/Vaccinium membranaceum-Xe phyllum tenax*, is at least sporadically r resented in the natural area. It is intermedi in character between the *Tsuga-Abies/Xe phyllum* and the *Abies/Achlys* types w significant coverage of *Vaccinium membra ceum, Xerophyllum tenax*, and several her

There are also a variety of nonfores communities in the Wildcat Mountain search Natural Area. These include: (1) co munities on logged and burned forest la (2) meadows of various types, (3) shrub c munities, and (4) communities associa with rock outcrops and cliffs. Small porti of areas clearcut and broadcast burned 1952 (in section 20) and 1967 (in secti 21 and 28) were incorporated into the natu area. The seral communities present on th areas are typical of early stages in second succession on forest habitats. Shrubs (e *Ceanothus velutinus*) dominate on the ol (more advanced) clearcut and herbs on other. Natural regeneration of conifers appearing in both.

The meadow communities in the natu area can largely be related to the Wet M dow, Mesic Meadow, and Subalpine X Meadow types recognized by Hickman (1 in comparable portions of the western cades. The Wet Meadow type is gener found on gentle slopes where a relati

rum viride, Senecio triangularis*, and *Valeriana sitchensis*. The Mesic Meadow type occupies habitats where moisture is typically adequate until midsummer. Dominants are *Rubus parviflorus*, *Pteridium aquilinum*, and *Rudbeckia occidentalis*. There are many associated herbaceous perennials, e.g., *Erigeron aliceae*, *Lupinus latifolius*, *Polygonum phytolaccaefolium*, *Cirsium centaurea*, and *Vicia americana* var. *truncata*, and occasional ephemeral annuals, e.g., *Gayophytum humile*. This type of meadow is probably the most extensive within the natural area. In some locations, invasion of trees, especially noble fir, is taking place; in others, there is no evidence for such successional changes, and the meadow community appears stable. Subalpine Xeric Meadows occur on sites with shallow, rocky soils where moisture becomes critical relatively early in the growing season. Representative species are *Gilia aggregata*, *Gayophytum diffusum* var. *parviflorum*, *Orthocarpus imbricatus*, *Polygonum douglasii*, *Navarretia divaricata*, *Microsteris gracilis*, *Collinsia parviflora*, *Cerastium arvense*, and *Rumex acetosella*.

Wet sites adjacent to the meadows and forest, steep, north-facing slopes on Wildcat Mountain, and talus associated with rock outcrops are occupied by shrub communities. Sitka alder is the typical dominant on wetter substrates and steep north slopes forming dense thickets. Deep winter snow accumulations and extensive snow creep cause strong bowing of the 3- to 5-m.-(10- to 16-ft.-) tall alder stems. In a nearby area, the occurrence of these stands has been related to high soil water tables due to a nearly impervious subsoil[4], while in other regions they are associated with recurrent avalanches; both factors are probably operative on the natural area. Vine maple dominates the shrub com-

[4] Unpublished soil survey data from the H. J. Andrews Experimental Forest, on file at U.S. Forest

... the same talus patch. Both types of shrub communities appear to be stable community types as there is generally no evidence of encroachment by tree species.

The communities found on rock outcrops and cliffs have not been examined. The species present undoubtedly include many of those listed by Hickman (1968) for the Outcrop Ridge and Vertical Outcrop habitats recognized in his floristic study of the western Cascades. The Outcrop Ridge habitat is found on south- and west-facing slopes, where mass wasting of small fragments has produced small outcrops of barely exposed parent rock eroded parallel to the general slope of the area. Many species root in weathered cracks or pockets of finer material, including *Delphinium menziesii* var. *pyramidale*, *Castilleja hispida*, *Penstemon procerus* var. *brachyanthus*, *Sedum stenopetalum* and *S. divergens*, *Eriophyllum lanatum*, *Arctostaphylos nevadensis*, *Comandra umbellata*, *Lomatium martindalei*, *Sanicula graveolens*, *Eriogonum compositum*, *Juniperus communis*, *Erigeron foliosus* var. *confinis*, *Arenaria capillaris* var. *americana*, *Erysimum asperum*, and *Phacelia heterophylla*. Species such as *Saxifraga bronchialis* var. *vespertina* and *Penstemon rupicola* are typical of the exposed Vertical Outcrop habitat.

Mammals believed to utilize the natural area as residents or transients are listed in table WM-2.

The only specialized habitats known to occur on the natural area, which have not already been mentioned, are the live stream and streamside areas.

HISTORY OF DISTURBANCE

Within the core of the natural area there has been some human disturbance. Minor disturbance was associated with construction and maintenance of the Wildcat Mountain trail and fire lookout. A small forest opening

of the various meadows found within the natural area.

Most human disturbance is along the southern margin of the area although it is considered minor; this area will probably also be the focus of any future problems. Two small areas (fig. WM-1) totalling about 4 ha. (10 acres) were clearcut prior to natural area establishment. Some mortality (mostly windthrow) is associated with the margins of these clearcuts and of Forest Road 147, particularly immediately northwest of the Wildcat-Bunchgrass Mountain saddle. Some damage from road construction (sidecast dirt and rock) also occurred in this area.

Natural disturbances appear to be minor within the natural area since the bulk of the stands were established 130 years or more ago. The scattering of younger stands suggests some minor wildfires have occurred in the last 50 years. Dwarf mistletoe is present in noble fir in at least some of the area, and there also appear to be small scattered pockets of root rot.

RESEARCH

A number of research projects are already in progress at Wildcat Mountain Research Natural Area:

1. Cone production by noble fir has been observed annually since 1961 (Franklin 1968) and that by mountain hemlock and Pacific silver fir since 1967.[5] This study will continue until at least 1972.

2. Total amount and quality of annual seedfall has been under study since 1968, and this research will continue until at least 1972.[6] Seedtraps are located within a pure noble fir stand at about 1,340 m. (4,400 ft.) in the southwestern portion of the natural

[5] Research by Dr. Jerry F. Franklin, U.S. Forest Service, Forestry Sciences Laboratory, Corvallis, Oregon.

[6] See footnote 5.

taken within the natural area as par study of the forest communities and environmental relationships in the c western Cascades of Oregon. These are incorporated into the resulting classifica

4. Numerous collections of soil fung been made within the natural area by Service and Oregon State Universit cologists.[8]

5. Stem analyses of noble fir and asso species have been made on specimen immediately adjacent to the natural Both the least and most productive sit represented in these samples. The d presently being analyzed (DeMars, He and Bell 1970; Herman and DeMars

This natural area is considered an a to the H. J. Andrews Experimental located 8 km. (5 miles) southwest, pro additional representation of high-ele true fir forest. The possibility exists of comparable forest areas on the experin forest for work involving destructive sar or manipulation and using the natura as a control site.

The H. J. Andrews Experimental (including Wildcat Mountain Researcl ural Area) is also an intensive stud for the U.S. International Biologica gram's Coniferous Forest Biome Anal Ecosystems project. Two plots being in this ecosystem research are located natural area.[9] One plot is located wi noble fir-Douglas-fir stand in the southw corner of the natural area and the ot located in a mountain hemlock-Pacific fir stand on the north slope of Bunc

[7] Research by Dr. C. T. Dyrness, U.S. Service, Forestry Sciences Laboratory, C Oregon.

[8] Research by Dr. James M. Trappe, U.S. Service, Forestry Sciences Laboratory, C Oregon.

[9] For additional information, contact Dr. J Franklin, U.S. Forest Service, Forestry S Laboratory, Corvallis, Oregon.

res, plant moisture stress, foliage nutrient ntent, and phenology are being monitored these plots. Many additional studies are anned for 1972 and 1973. Small mammal pulations are also under study within the ountain hemlock-Pacific silver fir stand.

The natural area provides a number of ecial research opportunities besides those ossible in connection with already active search projects. These include research on:) the two small watersheds which occupy e eastern half of the area; (2) subalpine ands of varying age, composition, and productivity, including some of pure noble fir; 3) mountain meadows typical of those found the western Cascades; and (4) succession small, recently cutover tracts incorporated ithin the natural area.

PHOTOGRAPHS

Special maps applicable to the natural are are: *Topography*—15′ Echo Mountain, Oregon quadrangle, scale 1:62,500, issued by th U.S. Geological Survey in 1955; and *geolog —Reconnaissance Geologic Map and Sectio of the Western Cascade Range/Oregon, Nort of Latitude 43° N.*, scale 1:250,000 (Pe et al. 1964), *Geologic Map of the Central Pa of the High Cascade Range, Oregon* (Wil iams 1957), and *Geologic Map of Oregon We of the 121st Meridian*, scale 1:500,000 (Pe 1961). Either the District Ranger (McKenz Bridge Ranger District) or Forest Supervis (Willamette National Forest, Eugene, Or gon) can provide details on the most rece aerial photo coverage and forest type ma for the area.

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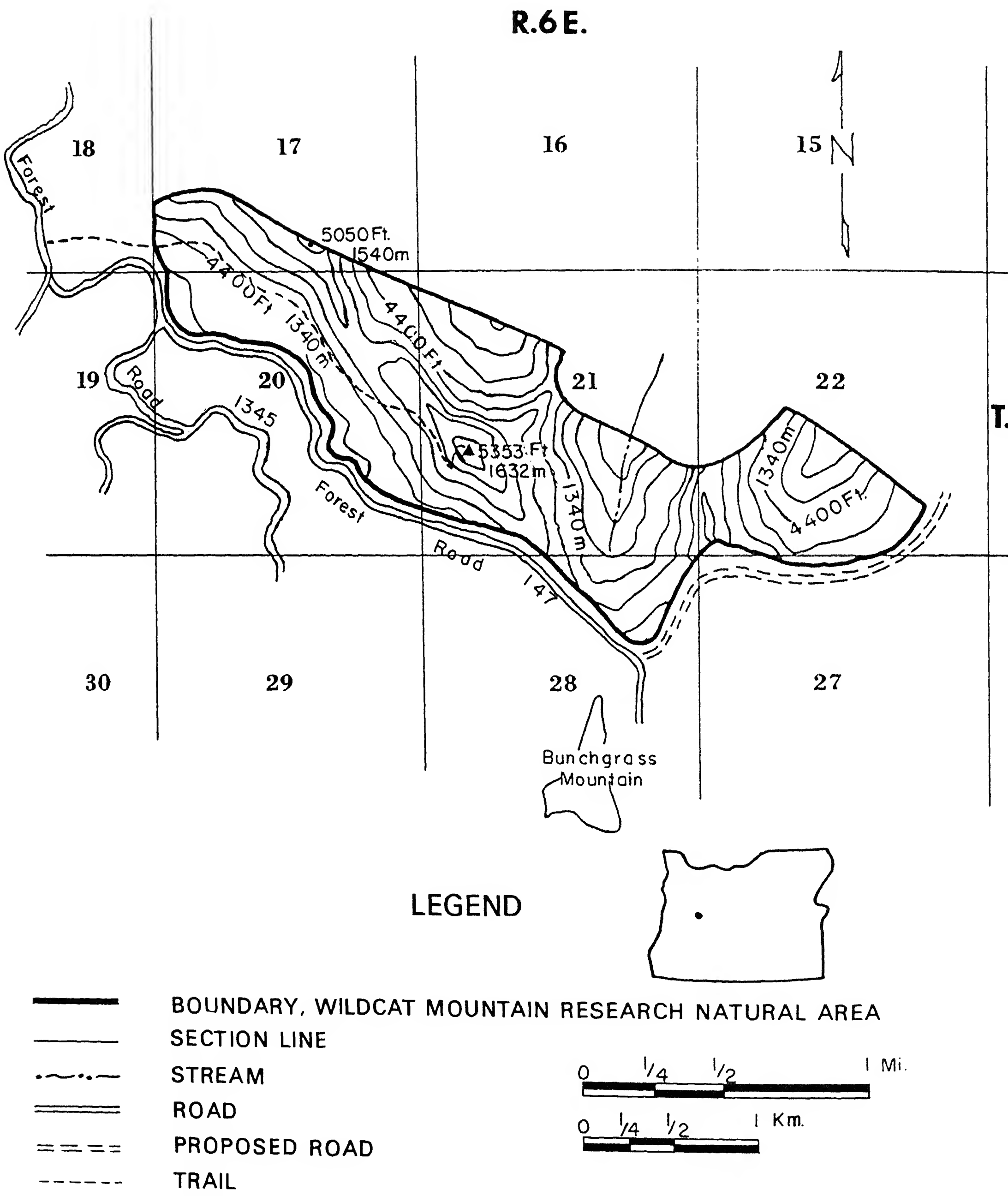
inventory type			Years	Ha.	Acres
Cutover	NF, DF	226	10	4.0	10
FM 1	MH, PSF	205	30	4.0	10
FM 1	PSF, MH	226	20	4.0	10
FM 1	NF	226	30	4.0	10
FM 2	PSF	226	70	2.0	5
FM 3	PSF, MH	226	120	12.2	30
FM 3	MH, PSF	205	140	18.2	45
FM 3	NF	226	70	4.0	10
FM 4	NF	226	120	8.1	20
FM 4	NF, DF	226	120	72.9	180
FM 4	NF, DF	226	300	48.6	120
FM 4	NF, PSF	226	300	36.4	90
FM 4	NF, PSF, MH	226	350	28.4	70
FM 4	PSF, MH, NF	226	350	20.2	50
D 4	DF, NF	226	120	4.0	10
D 4	DF, NF, WH	230	180	16.2	40
TOTAL				287.6	710

[1] Based on 1960 inventory of the Willamette National Forest.

[2] Alphabetical symbols refer to forest type: FM, true fir-mountain hemlock; and D, Douglas-fir. Numeric symbols refer to size class: 1, seedlings and saplings, 0- to 5-in. d.b.h.; 2, pole timber, 5- to 11-in. d.b.h.; 3, small sawtimber, 11- to 21-in. d.b.h.; and 4, large sawtimber, 21-in. and larger d.b.h.

[3] In approximate order of importance. Abbreviations are: NF, noble fir; DF, Douglas-fir; MH, mountain hemlock; PSF, Pacific silver fir; and WH, western hemlock.

		coast mole
	Scapanus townsendi	Townsend mole
	Sorex bendirii	marsh shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
	Ochotona princeps	pika
Rodentia	*Aplodontia rufa*	mountain beaver
	Arborimus albipes	white-footed vole
	Arborimus longicaudus	red tree vole
	Clethrionomys californicus	California red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus richardsoni	Richardson vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Tamiasciurus douglasi	chickaree
	Thomomys mazama	Mazama pocket gopher
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Canis lupus	wolf
	Felis concolor	mountain lion or cougar
	Gulo luscus	wolverine
	Lynx rufus	bobcat
	Martes americana	marten
	Martes pennanti	fisher
	Mustela erminea	short-tailed weasel or ermin
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. hemionus	mule deer



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4400Ft
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Mountain
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BOUNDARY, WILDCAT MOUNTAIN RESEARCH NATURAL AREA
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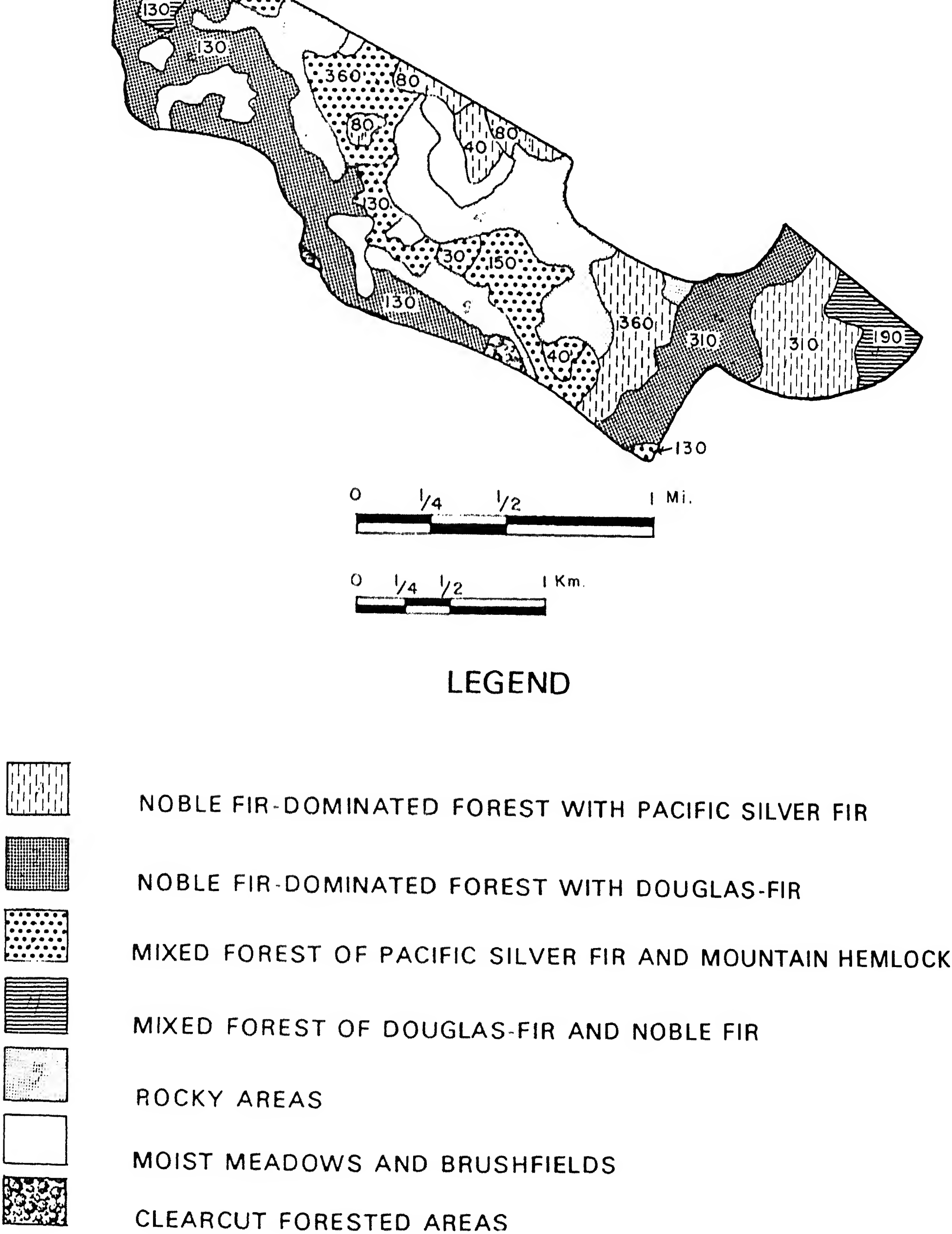

Figure WM-2.– Forest types and age classes in the Wildcat Mountain Research Natural Area.
(Data source: 1960 inventory, Willamette National Forest.)

Figure WM-3.—Forest communities of Wildcat Mountain Research Natural Area. Upper left: Community of *Tsuga mertensiana-Abies amabilis/Xerophyllum tenax*; the approximately 130-year-old trees average 30- to 60-cm. (12- to 24-in.) d.b.h. Upper right: Nearly pure stand of noble fir growing along Wildcat Mountain trail; these approximately 130-year-old trees average 75-cm. (30-in.) d.b.h. and 45 m. (150 ft.) tall. Lower left: Older stand (approximately 180 years) of noble fir showing abundant seedlings and saplings of Pacific silver fir, the probable climax species. Lower right: Collecting contents of seedtrap in stand of mountain hemlock and Pacific silver fir as part of long-term study of tree seeding habits on the natural area.




WILLAMETTE
FLOODPLAIN RESEARCH
NATURAL AREA[1]

Grassland and Oregon ash forest on wet bottom lands in Oregon's Willamette Valley.

The Willamette Floodplain Research Natural Area provides an excellent example of the grassland-forest community mosaic found in wet valley-bottom habitats or flood plains in western Oregon's Willamette Valley. Originally established on December 27, 1966, to exemplify unplowed, near-natural grasslands, it has since been relocated and enlarged to include typical flood plain forests of Oregon ash (*Fraxinus latifolia*). The 97-ha. (239-acre) tract is located in Benton County, Oregon, and is administered by the William L. Finley National Wildlife Refuge (Route 2, Box 208, Corvallis, Oregon), Bureau of Sport Fisheries and Wildlife. It occupies portions of section 3, T. 13 S., R. 5 W., Willamette meridian, at 44°26′ N. latitude and 123°18′ W. longitude (fig. WP-1).

ACCESS AND ACCOMMODATIONS

The natural area is located about 16 km. (10 miles) south of Corvallis, a short distance west of U.S. Highway 99W. A graveled all-weather road provides access to within a few hundred feet of the west boundary; from there travel is by foot cross-country and over fire trails. Cross-country travel to and through the tract (except for the crossing of Muddy Creek) is very easy because of the gentle ground. Commercial accommodations are available in Corvallis; there are no public campgrounds within the Refuge.

ENVIRONMENT

The Willamette Floodplain Research Natural Area is located on essentially flat topography typical of the floor of the Willamette Valley. Elevation ranges from about 82 to 88 m. (270 to 290 ft.). Gentle swales and ridges, which are most easily distinguished on aerial photographs, provide the only relief. Muddy Creek, a small, turbid, meandering, valley-bottom stream, flows through the center of the area.

The natural area is located on valley bottom alluvium consisting of unconsolidated silts, sands and gravels (Vokes, Myers, and Hoover 1954). These alluvial materials belong to a group known as the Willamette silts, which are believed to be of the Wisconsin age, and to a Recent group. Piper (1942) provides additional details on these materials.

The natural area is located in western Oregon, an area of mild, moist climate. However, it is within the Willamette Valley, which is located between the Coast and Cascade Ranges and is, therefore, subject to the somewhat warmer and drier climate typical of interior western Oregon valleys. The summer dry period is especially pronounced. Representative climatic data from the Corvallis weather station, which is about 16 km. (10 miles) north, are as follows (U.S. Weather Bureau 1965):

Mean annual temperature	11.6°C. (53.0°F.)
Mean January temperature	4.1°C. (39.4°F.)
Mean July temperature	19.2°C. (66.6°F.)
Mean January minimum temperature	0.6°C. (33.1°F.)
Mean July maximum temperature	27.1°C. (80.8°F.)
Average annual precipitation	957 mm. (37.67 in.)

[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Pacific Northwest Forest

cent, respectively. The grasslands occupy a mosaic of Dayton and Woodburn silt loams. The forested areas are mainly found on the Dayton series (80 percent), with some Waldo series along the western boundary. The relationships of several of these soils to geomorphic surfaces have been described by Balster and Parsons (1968). The Dayton series has been classified as a Planosol and Typic Albaqualf by the old and new soil classifications, respectively. It consists of a shallow, poorly drained silt loam over clay developed in water-deposited silts over older underlying materials. A typical horizon sequence is as follows (the plow layer (Ap) is, of course, absent in the natural area): Dark grayish brown Ap from 0 to 20 cm.; Grayish silty clay loam A2 from 20 to 38 cm.; and Dark grayish clayey IIB2t from 38 to 83 cm. Detailed studies have shown that the boundaries between the A2, B2, and C horizons represent depositional discontinuities (Parsons and Balster 1967). The Woodburn silt loam can be classified as a Brunizem or Aqualtic Argixeroll. The very deep moderately well-drained silt loam surface soil and silty clay loam subsoil is developed in silty alluvial deposits. A typical horizon sequence is as follows (the plow layer (Ap) is absent in the natural area): Very dark grayish brown Ap from 0 to 20 cm.; Dark brown A3 from 20 to 40 cm.; Dark brown B1 from 40 to 60 cm.; and a dark brown silty clay loam B2t from 60 to 120 cm.

BIOTA

The natural area is almost evenly divided between grassland and forest. The grasslands occupy about 50 ha. (123 acres), mostly in the eastern half of the tract. Forests, dominantly of Oregon ash, cover 47 ha. (116 acres) in the western half of the natural area. The ash forests can be related to Küchler's (1964) Type 25, Alder-Ash Forest. The natural area is located within the Interior Valley (*Pinus*-

wet bottom land habitat anywhere
Willamette Valley. These communitie
rich mixture of native and introduced
and of grasses, grasslike plants, an
Typical dominants include *Carex ov*
leporina, *Alopecurus geniculatus*, *Des*
sia caespitosa, and *Hordeum brachyan*
Forbs commonly encountered include
ga integrifolia, *Lomatium bradshawi*
lea millefolium, *Ranunculus orthorh*
Veronica scutellata, *Potentilla gracil*
sotis versicolor, *Sidalcia nelsoniana*,
trifidum, and *Hypericum perforatum*
species known to occur include *Sidalcia*
stris, *Geranium dissectum*, *G. molle*, *C*
parviflora, *Cardamine oligosperma*, *L*
spp., *Cerastium glomeratum*, *Plantago*
lata, *Luzula comosa*, *Carex lanugi*
unilateralis, *Rumex acetosella*, *Dipsa*
vestris, *Trifolium dubium*, *Mimulus g*
Sisyrinchium angustifolium, *Juncus c*
J. bufonius, *Bromus commutatus*, *F*
vesca, *Geranium oreganum*, *Orthocar*
pidus, and *Epilobium glandulosu*
champsia danthonioides and *Plagio*
figuratus are common dominants on d
microsites.

Some shrub and tree species are abu
scattered through the natural area.
ash, *Rosa nutkana*, *Spiraea douglasi*
fusca, *Crataegus douglasii*, and *Ame*
alnifolia are among the more commo
photographs (Fig. WP-1) reveal that
and shrubs are not uniformly distribu
the grassland; instead they appear to
est on convex topography or mic
Woody plants appear to be extendi
range and increasing their dominance
grassland areas, suggesting gradual
sional replacement of the existing he
communities by trees and shrubs (fig
This invasion is probably a conseq
fire control programs; most natura
lands found in the Willamette Valley

nds on the natural area. Before this is ttempted, burning will be tested as a anagement technique on a similar, nearby rea.

Very little descriptive work has as yet been rried out on the forest stands. Oregon ash is e major dominant but Oregon white oak *uercus garryana*) becomes a codominant or minant in the stands located west of Muddy reek (fig. WP-2). The Oregon ash stands ry considerably in age and in density and mposition of understory. Some of the denser ung stands have essentially no ground vegetion. All of the lowland forest is, of course, bject to flooding by the overflow of Muddy eek every winter.

Mammals which are believed to occur on e Willamette Floodplain Research Natural ea as residents or transients are listed in ble WP-1. The western pond turtle (*Clem-s marmorata*) is found in Muddy Creek.

Many different bird species may be encoun-ed within the natural area; a complete ecklist of the birds for the Refuge is avail-e at Refuge Headquarters. Among those quenting the natural area itself are all of e water fowl which periodically feed on d, such as the dusty Canada goose (*Branta adensis* var. *occidentalis*), for which the dlife refuge was established, marsh hawk *rcus cyaneus*), short-eared owl (*Asio flam-us*), red-tailed hawk (*Buteo jamaicensis*), gh-legged hawk (*Buteo lagopus*), western adowlarks (*Sturnella neglecta*), golden-wned sparrows (*Zonotrichia atricapilla*), thern shrike (*Lanius excubitor*), ring-ked pheasant (*Phasianus colchicus*), Cali-nia quail (*Lophortyx californicus*), and white (*Colinus virginianus*). Large numbers mallards (*Anas platyrhynchos*) are encoun-ed along Muddy Creek at certain times of year.

STORY OF DISTURBANCE

ject to heavy grazing and were probably burned periodically prior to establishment of the refuge in 1963. The grassland stand in the southwestern corner of the natural area is an abandoned field which is gradually under-going colonization by native plants; the field was abandoned some time prior to 1964.

RESEARCH

The only research conducted thus far on the Willamette Floodplain Research Natural area is by undergraduate students in ecology and wildlife from Oregon State University; the Refuge Manager can provide details.

The natural area is a uniquely valuable research site. It is one of only two scientific reserves which includes stands of Oregon ash and provides the only protected example of seminatural, unplowed Willamette Valley grassland. Among the many opportunities for research include studies of: (1) successional processes, particularly in connection with the burning program planned for a portion of the natural area; (2) variation in community composition in relation to microtopography (swale vs. ridge); (3) the role of various intro-duced plant species; (4) long-term changes in the forest-grassland boundary; and (5) aquatic and semiaquatic organisms associated with a meandering valley stream.

MAPS AND AERIAL PHOTOGRAPHS

There are no special maps of sufficient de-tail to be of value. Aerial photographs taken in June 1970 are available from the Agricul-tural Stabilization and Conservation Service, Benton County ASC Committee, P.O. Box 1027, Corvallis, Oregon. The photo providing the best coverage of the natural area is DEJ-

Exp. Stn. Spec. Rep. 265, 31 p., illus.

Franklin, Jerry F., and C. T. Dyrness
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1942. Ground-water resources of the mette Valley, Oregon. U.S. Surv. Water-Supply Pap. 890, illus.

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1965. Climatic summary of the States — supplement fo through 1960, Oregon. Clim phy of the United States 86-31 illus.

Vokes, H. E., D. A. Myers, and Linn
1954. Geology of the west central area of the Willamette Valle gon. U.S. Geol. Surv. Oil Invest. Map OM-150.

Order	Scientific name	Common name
Marsupialia	*Didelphis marsupialis*	opossum
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus townsendi	Townsend mole
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Sylvilagus bachmani*	brush rabbit
	Sylvilagus floridanus	eastern cottontail
Rodentia	*Eutamias townsendi*	Townsend chipmunk
	Microtus canicaudus	gray-tailed vole
	Microtus townsendi	Townsend vole
	Myocastor coypus	nutria
	Neotoma fuscipes	dusky-footed wood rat
	Ondatra zibethicus	muskrat
	Peromyscus maniculatus	deer mouse
	Spermophilus beecheyi	California ground squirrel
	Thomomys bulbivorus	giant pocket gopher
Carnivora	*Canis latrans*	coyote
	Lynx rufus	bobcat
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Procyon lotor	raccoon
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Odocoileus h. columbianus*	black-tailed deer

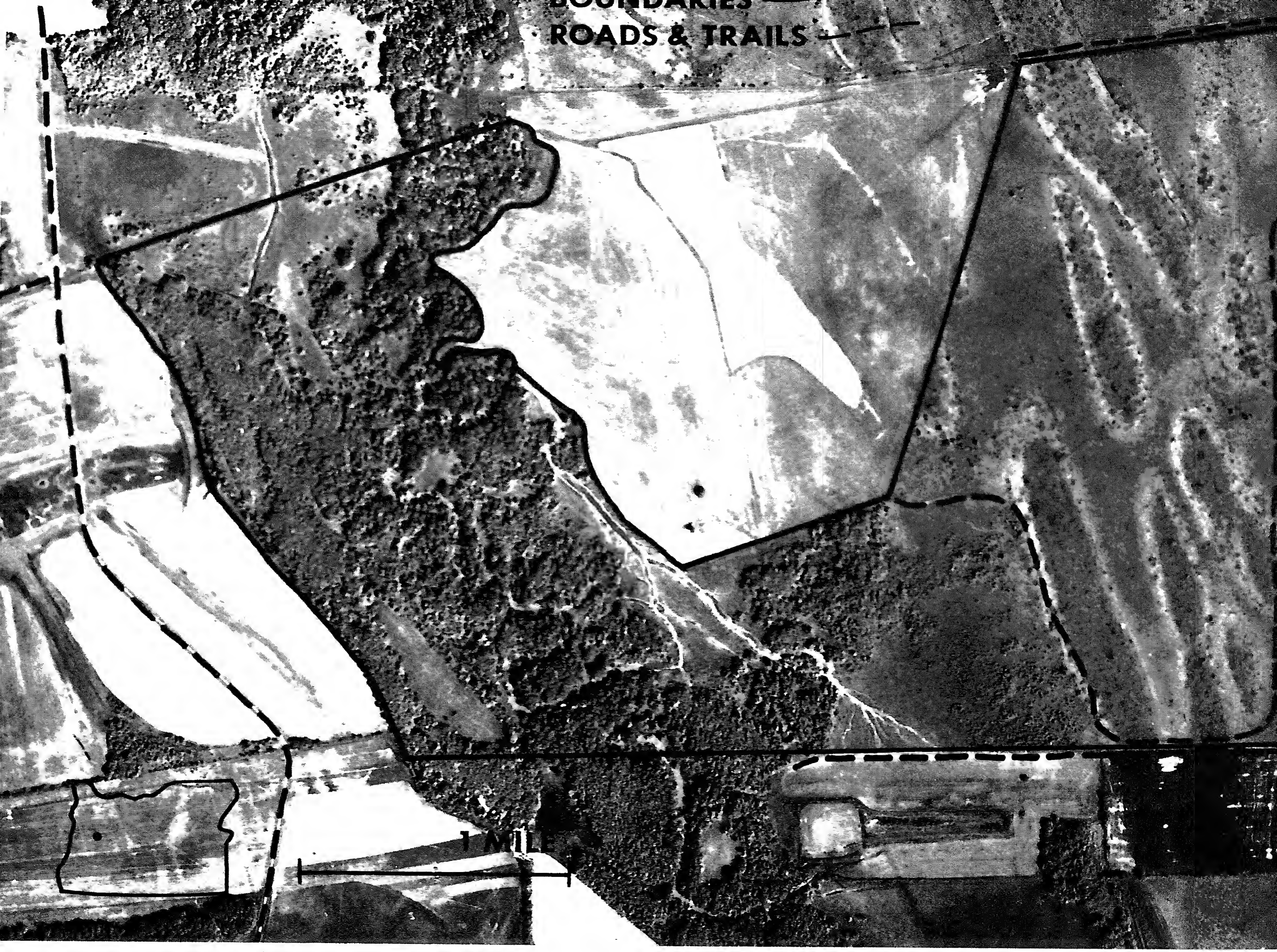

Figure WP-1.– Aerial photograph of Willamette Floodplain Research Natural Area

Figure WP-2.—Natural features of Willamette Floodplain R search Natural Area. Upper left: Typical view of Mudc Creek showing streamside forest dominated by Orego ash. Upper right: Grassland and Oregon white oa dominated stand in southeastern corner of the natur area; note the mistletoe in the oak trees. Lower lef Portion of grassland which has been lightly invaded b shrubs and trees; invading *Crataegus* (background) and patch of *Spiraea* (center) are visible. Lower right: Gras land area dominated by *Deschampsia caespitos* *Alopecurus geniculatus,* and *Carex* spp.




WIND RIVER RESEARCH NATURAL AREA[1]

Old-growth Douglas-fir - western hemlock stands growing in a valley in the southern Washington Cascade Range.

The Wind River Research Natural Area as established on March 28, 1934, to exem-lify the old-growth Douglas-fir (*Pseudotsuga enziesii*) - western hemlock (*Tsuga hetero-hylla*) forests which originally covered many alleys in western Washington's Cascade ange. The 478-ha. (1,180 acre) tract is lo ted in Skamania County, Washington, and administered by the Wind River Ranger strict (Carson, Washington), Gifford Pin-ot National Forest. It is also a part of the ind River Experimental Forest, a 1,380 ha. 0,815-acre) area maintained by the Pacific orthwest Forest and Range Experiment ation for research and demonstration of anagement techniques in the Douglas-fir pe (U.S. Forest Service 1961). The tract cupies portions of sections 8, 17, 20, and T. 4 N., R. 7 E., Willamette meridian g. WR-1). Boundaries are based on legal criptions except for the southern boundary section 20 which is 90 m. (300 ft.) north of l parallel to Trout Creek. The natural area s at 45°49' N. latitude and 121°58' W. gitude.

CCESS AND CCOMMODATIONS

t is easiest to reach the natural area from the south via the Columbia River (U.S. Highway 830), Carson, and the Wind River valley following Forest Highway 30 and Forest Road N411 to Hemlock Ranger Station (Wind River Ranger District). Just west of the ranger station turn onto Forest Road N417, which crosses the southwestern corner of the natural area about 3.2 km. (2 miles) from the station (fig. WR-1). The eastern edge of the natural area can be reached and is crossed by Forest Road N400, a low standard road which leads north from Forest Road N417 about 0.8 km. (0.5 mile) west of the ranger station.

A trail crosses section 20 and follows the northern edge of section 21, connecting Forest Roads N417 and N400 and providing access to the southern half of the natural area. The northern half is probably easiest to reach by cross-country travel from Forest Road N46 which climbs the eastern slopes of Trout Creek Hill just west of the natural area boundary.

The nearest commercial accommodations are in Stevenson, about 24 km. (15 miles) away. However, there are several improved forest camps in adjacent portions of the Wind River valley.

ENVIRONMENT

The natural area occupies gently sloping or undulating topography on the lower slopes of the Wind River valley and Trout Creek Hill, an extinct shield volcano (fig. WR-1). Topography is somewhat steeper in the northwestern corner and at the extreme eastern edge of the natural area on the slopes of Trout Creek Hill and Bunker Hill, respectively. Portions of the area (e.g., in the NW1/4 of section 21) are nearly flat and relatively moist. There is also significant area of swamp, marsh, and open water along the western base of Bunker Hill.

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[1] Description prepared by Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, [illegible]

part of the flows which originated on Trout Creek Hill. Wise (1970) has provided some petrological information on these basalts. Trout Creek Hill is surmounted by two cinder cones, and bedrock in the natural area is rarely encountered due to various surface deposits. Most of these, if not all, are composed of volcanic ejecta of unknown sources. The lower slopes of Bunker Hill, at the extreme eastern edge of the natural area, are occupied by Eocene to Oligocene andesitic to rhyodacitic pyroclastic rocks belonging to the Ohanapecosh Formation (Wise 1970).

A cool, moist climate prevails. Precipitation is seasonal, peaking during winter months and reaching lowest levels during the summer. Summer drought periods of 2 months' duration have been recorded (Steele 1952). Much of the winter precipitation occurs as snow, and at least some snow cover typically blankets the natural area during most of the winter. The following climatic data are for the Hemlock Ranger Station located about 3 km. (2 miles) southeast of the natural area and are probably quite representative of conditions there (Wind River Station in U.S. Weather Bureau 1965); additional climatic data are summarized by Steele (1952):

Mean annual temperature	8.7°C. (47.8°F.)
Mean January temperature	0.0°C. (32.0°F.)
Mean July temperature	17.5°C. (63.5°F.)
Mean January minimum temperature	−3.7°C. (25.3°F.)
Mean July maximum temperature	26.9°C. (80.5°F.)
Average annual precipitation	2,528 mm. (99.51 in.)
June through August precipitation	119 mm. (4.67 in.)
Average annual snowfall	233 cm. (91.7 in.)

Soils have not been mapped within the natural area. However, at least some profiles are similar morphologically to the Stabler shotty loam soil series described from nearby areas during a Skamania County soil survey (Anderson et al. 1956). This series was categorized as a "Brown Podzolic - Brown Later-

01	4 to 3 cm.	Undecomposed ... matter; pH 4.7.
02	3 to 0 cm.	Mainly decompos... recognizable ... matter; pH 4.3.
A1	0 to 25 cm.	Dark brown shott... y loam; granular... ture; abundant ... tions; pH 5.3.
A3	25 to 50	Brown shotty ... loam; weak, ... subangular block... ture; abundant ... tions; pH 5.4.
B21	50 to 74 cm.	Dark yellowish ... sandy loam; m... medium sub... blocky structur... 6.3.
IIB22	74 to 81 cm.	Strong brown ... lowish brown ... loam; massive ... ture; common, ... sized, weathere... pumice; pH 6.0.
IIIB23	81 to 132 cm.	Dark yellowish ... loam; strong coa... angular blocky ... ture; common, s... weathered, grav... pumice; pH 5.9.
IIIB24	132 to 170 cm.	Yellowish red ... sand; weak, ... subangular block... ture; occasion... verely-weathere... el-sized pumice; ... ingly vesicula... depth; pH 6.1.
IIIB3	170 to 190 cm.+	Dark grayish ... loamy sand; ... common, sever... thered, grav... pumice; abunda... dish brown mot... 6.0.

These soils are certainly not develop... marily from residual parent material... canic ejecta appear to make up the ... the surface soil and have probably be... posited by both wind and water. Laye... parent materials is apparent in many p... including the one described above.

OTA

For convenience all 478 ha. (1,180 acres) of e natural area can be classified as SAF cover pe 230, Douglas-Fir - Western Hemlock ociety of American Foresters 1954), and ichler's (1964) Type 2, Cedar - Hemlock - ouglas Fir Forest. Localized areas could obably be typed as SAF type 224, Western emlock. Some of the swampier ground on e eastern edge of the natural area has sub-antial amounts of western redcedar (*Thuja licata*), and there is some acreage of open ater and marsh. The natural area is located ithin the *Tsuga heterophylla* Zone of Frank-n and Dyrness (1969). However, it contains surprising number of subalpine or montane *Abies amabilis* Zone) elements, considering he low elevation it occupies; e.g., an abun-ance of Pacific silver fir (*Abies amabilis*), ccasional noble fir (*Abies procera*), and the moss *Rhytidiopsis robusta*. This may be par-ially due to valley microclimatic influences.

Most of the natural area is occupied by 350-year-old forest stands but there are some small areas of younger age classes (fig. WR-1). Most notable is the approximately 70-year-old Douglas-fir stand located south of Forest Road N417 in section 20. This stand dates from the 1902 Yacolt Burn. Two small areas along the northeastern boundary of the natural area were accidentally logged when the adjacent, then private, forest lands were cut 50 to 60 years ago; they are now occupied by a second-growth Douglas-fir stand.

Tree species found within the natural area include Douglas-fir, western hemlock, western redcedar, Pacific silver fir, western white pine (*Pinus monticola*), and noble fir. The relative importance of the species, in terms of stand volume, is shown in table WR-1. The exact composition of the stands varies through the natural area. In some, Douglas-fir has been completely replaced by western hemlock and

area have been studied since 1947 (table WR-1). Site productivity is only moderate, with an average Douglas-fir site index of 130 (a low class III) indicating Douglas-fir dominants should average 40 m. (130 ft.) in height at the index age of 100 years. The 350-year-old stand contains a total stand volume of 1,053 cu. m. per ha. (96,880 bd. ft. per acre) and is making considerable annual growth despite its advanced age (table WR-1). Most of the growth is offset by mortality in the Douglas-fir and western white pine, however. An epi-demic of Douglas-fir bark beetles (*Dendroc-tonus pseudotsugae*), which climaxed durin 1951 to 1953, and windthrow (fig. WR-2) hav been the chief causes of mortality in Douglas-fir. Mountain pine beetles (*Dendroctonu monticolae*) and white pine blister rust (*Cro-nartium ribicola*) have practically eliminate the western white pine. Some western hem-lock have been lost to windthrow and dwa mistletoe (*Arceuthobium campylopodum*) i fections.

Forest stands in the natural area are pr-gressing toward a climax of western hemlo and Pacific silver fir, a process accelerated l heavy mortality in the Douglas-fir overstor Although Pacific silver fir is below its norm elevational range as a climax species for th part of the Cascade Range, it is reproduci throughout most of the natural area. In ma stands Pacific silver fir seedlings and saplin are as abundant as, or more so than, those western hemlock. The growth and mortal data (table WR-1) further illustrate the cou of stand succession with heavy losses of Dou-las-fir and western white pine from the ov story.

Typical understory dominants vary c siderably with local site conditions. O much of the area, small trees form a sec canopy level 5 to 10 m. (15 to 35 ft.) in heig made up of vine maple (*Acer circinatu* Pacific dogwood (*Cornus nuttallii*), and P Pacific yew (*Taxus brevifolia*) (fig. WR-2)

tonia uniflora, Achlys triphylla, Pteridium aquilinum, Xerophyllum tenax, Linnaea borealis, Trillium ovatum, Anemone deltoidea, Chimaphila umbellata, and *C. menziesii.* Major mosses are *Eurhynchium oreganum, Camptothecium megaptilum,* and *Rhytidiopsis robusta.* Moister habitats have greater coverage of herbaceous species and less fertile or drier habitats greater amounts of ericads, such as *Gaultheria shallon* and *Xerophyllum tenax.* Two stands sampled during a study of forest communities in the southern Washington Cascade Range were assigned to an *Abies amabilis/Gaultheria shallon* Association (Franklin 1966); at least a part of the area could be characterized by a *Tsuga heterophylla/Acer circinatum - Berberis nervosa* Association.

Mammals believed to utilize the natural area as residents or transients are listed in Table WR-2. Some minor hunting of larger game animals occurs within the natural area.

Shelford (1963) observed that ants (*Formica rufa melanotica*) were the commonest insects on animal paths. Tenebrionid beetles (*Iphthinus serratus*) and tiger beetle larvae were also in evidence. He also collected western toads (*Bufo boreas*) and tailed frogs (*Ascaphus truei*) from the natural area.

There are no permanent streams within the natural area. The ponds and swamps at the foot of Bunker Hill provide the major areas of aquatic and semiaquatic habitat (fig. WR-2).

HISTORY OF DISTURBANCE

Human disturbance of the natural area is minor and confined to the boundaries and roadside and trailside areas. Lands on the north side of the natural area were logged 50 to 60 years ago. These have now regenerated and are occupied by young conifer forest, minimizing present edge effects. A logging railroad once crossed the extreme eastern boundary of the natural area, but the aban-

natural area.

Natural disturbances appear to be typical of overmature conifer forest in region, i.e., losses to windthrow and va pathogens mentioned earlier. Except fo small area burned in 1902, there is no evid for wildfires within the natural area du the last 200 to 300 years.

RESEARCH

Wind River Research Natural Area long history of research. Many of the ecological studies of Douglas-fir were ca out here by Leo A. Isaac and his asso (e.g., Isaac 1940, 1943). Included were o vations on natural seedfall, seed storage i forest floor, seed germination under timber, phenology, and moisture conte the forest floor. The screens used to pr seed stored in the forest floor in 1928 (1940) were located during a reconnais of the area in 1969 (fig. WR-2).

The long-term study of tree growth mortality established in 1947 and cited lier (Steele and Worthington 1955, 1961) is continuing. This study utilizes four 0.08-ha. (1/5-acre) growth plots hundred and eight 0.40-ha. (1-acre) mor plots, and twenty-seven 0.0016-ha. (4-mi ground vegetation plots systematically s over the natural area. A remeasuremen completed in 1971 and provides 24 yea record.

Numerous observations have been within the natural area by visiting bota zoologists, foresters, and soil scientists. ever, these data were generally not pub with specific reference to the natural The natural area was used as a samplin for a study of forest communities and s the southern Washington Cascade (Franklin 1966).

Wind River Research Natural Area

nvironment. The possibility exists of using ther parts of the experimental forest for ork involving destructive sampling or anipulation and using the natural area as ontrol site.

IAPS AND AERIAL HOTOGRAPHS

Special maps applicable to the natural area e: *Topography* — 15' Wind River, Wash- gton quadrangle, scale 1:62,500, issued by e U.S. Geological Survey in 1957; and *ology* — *Geologic Map of Washington*, ale 1:500,000 (Huntting et al. 1961), and *ologic Map and Sections of the Wind River ea, Skamania County, Washington*, scale

... equals 1 mile (Wise 1970). Either the District Ranger (Wind River Ranger District) or Forest Supervisor (Gifford Pinchot National Forest, Vancouver, Washington) can provide details on the most recent aerial photo coverage and forest type maps for the area.

Copies of a topographic map (scale 4 in. or 8 in. equals 1 mile, 50- or 10-foot contour intervals) for the Trout Creek Division of the Wind River Experimental Forest, including the natural area, are on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. This map was prepared by Forest Service personnel in 1934. Records of a 1934 cruise of the area, and a very generalized type map based upon it, are also on file there.

Don Klauss, and Clarence Lounsbury
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1954. Forest cover types of North Ame (exclusive of Mexico). 67 p., il Washington, D.C.

Steele, Robert W.
1952. Wind River climatological data 1 1950. Pac. Northwest Forest & Ra Exp. Stn. USDA Forest Serv., 2 Portland, Oreg.

——— and Norman P. Worthington
1955. Increment and mortality in a vi Douglas-fir forest. Pac. Northv Forest & Range Exp. Sta. US Forest Serv. Res. Note 110, 6 p., il Portland, Oreg.

U.S. Forest Service
1951. A guide to the Wind River Exp mental Forest near Carson, Wa ington. Pac. Northwest Forest Range Exp. Stn. USDA Forest S 20 p., illus. Portland, Oreg.

U.S. Weather Bureau
1965. Climatic summary of the Un States — supplement for 1 through 1960, Washington. Clima raphy of the United States 86 92 p., illus.

Wise, William S.
1970. Cenozoic volcanism in the Casc Mountains of southern Washing Wash. Dep. Conserv., Div. Mine Geol. Bull. 60, 45 p., illus.

Species	Inventory [illegible]		Gross growth [illegible]	Mortality	Net growth	Gross growth	Mortality	Net growth
	Cu. m./ha [illegible]	Bd. ft./acre [illegible]		Cu. m./ha.		. . . . . . Bd. ft./acre		
Douglas-fir	[illegible]	[illegible]	[illegible]	3.6	1.8	179	350	−171
Western hemlock	[illegible]	[illegible]	[illegible]	1.[illegible]	2.5	397	149	248
Pacific silver fir	[illegible]	[illegible]	[illegible]	.6	.2	72	31	41
Western redcedar	[illegible]	[illegible]	[illegible]	.1	.3	45	13	32
Western white pine	[illegible]	[illegible]	[illegible]	[illegible]	.6	6	71	− 65
TOTAL	1,[illegible]	[illegible]	[illegible]	[illegible]	.7	699	614	85

[1] Adapted from King [illegible] all trees 6.6-cm. (2.6 in. [illegible] stem. Board-foot volume [illegible] trees 29.5 cm. (11.6 in. [illegible] (8-in.) top.

Insectivora	*Neurotrichus gibbsii*	
	Scapanus orarius	coast mole
	Sorex obscurus	dusky shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket gopher
	Zapus princeps	western jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer

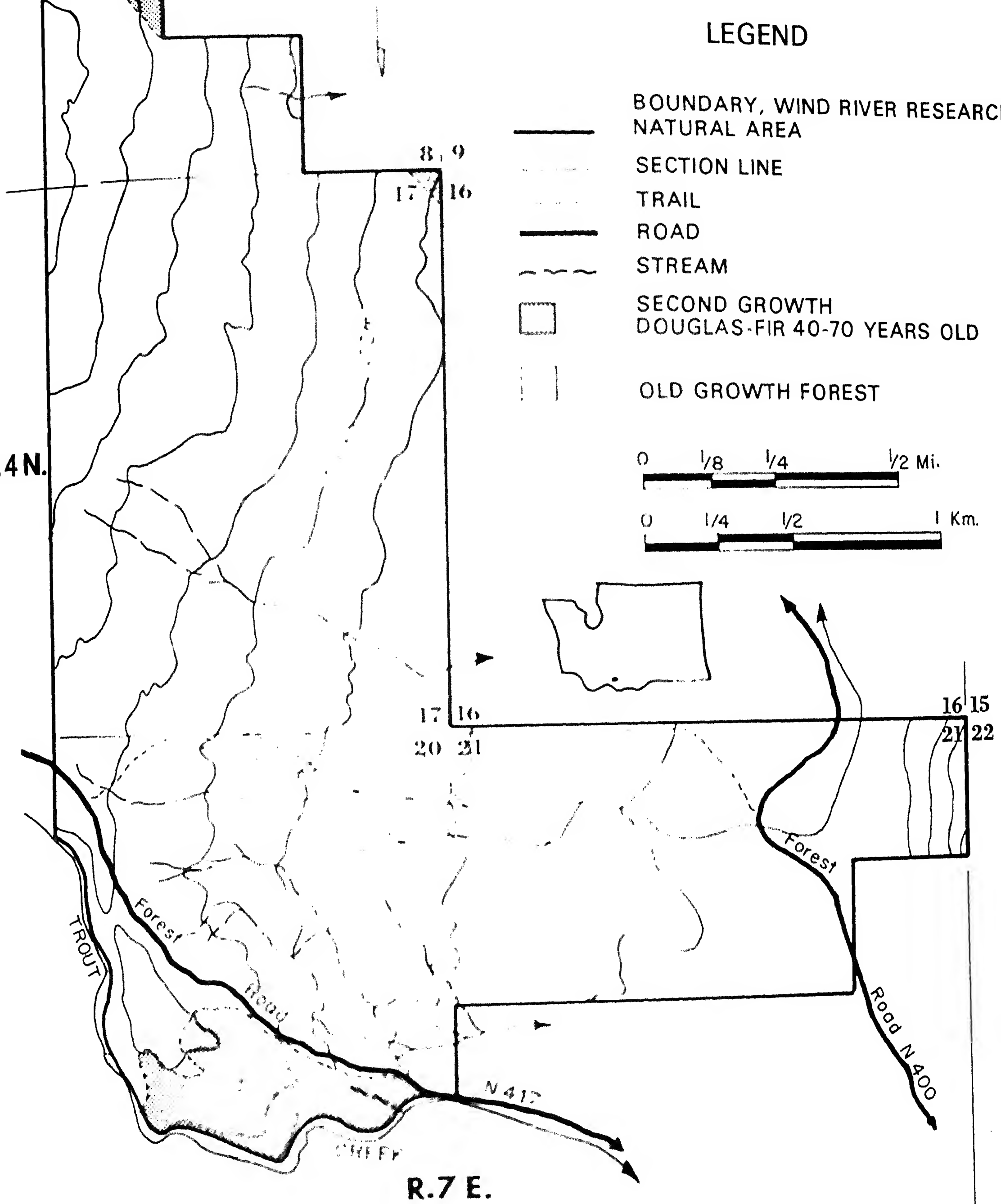


Figure WR 1 Wind River Research Natural Area,

Figure WR-2.—Features of the Wind River Research Nat
Area. A: Windthrown old-growth Douglas-fir; subs
tial and continuing mortality of Douglas-fir is ta
place due to insects, disease, and wind. B: Cluste
typical old-growth Douglas-fir trees. C: Pacific ye
one of several conspicuous subordinate trees fo
within the natural area. D: Fine stand of old-gro
Douglas-firs along Forest Road N400.

A

B

C

D

Figure WR-2.—Features of the Wind River Research N
Area (continued). E: Screened frames used by Leo
in his 1928 study of tree seed storage in the forest
F: Mixed stand of Douglas-fir and western he
showing typical understory dominants—vine mapl
Berberis nervosa; note the Pacific silver fir sapling
center of the picture. G: Swampy area at the fo
Bunker Hill which was probably created, at least in
by beaver activity; the dead trees are mostly w
redcedar. H: Small pond, marsh, and swamp at th
of Bunker Hill at the eastern edge of the natural ar

G

H

WOLF CREEK RESEARCH NATURAL AREA[1]

Bitterbrush - bunchgrass communities on granitic soils located along the lower east slope of the northern Washington Cascade Range.

The Wolf Creek Research Natural Area was established February 1969 as an example of the bitterbrush (*Purshia tridentata*) - bunchgrass vegetation which occurs on granitic soils at low elevations on the east slope of the Washington Cascades. This vegetation type is important as winter range for big game animals. The 61-ha. (150-acre) tract is located in Okanogan County, Washington, and is administered by the Winthrop Ranger District (Winthrop, Washington), Okanogan National Forest. It is rectangular in shape; the east, north, and west edges are partly fenced and follow surveyed section lines and its south edge borders Wolf Creek (fig. WW-1). It is located in the N1/2 of section 1, T. 34 N., R. 20 E., Willamette meridian, at 48°30′ N. latitude and 120°15′ W. longitude.

ACCESS AND ACCOMMODATIONS

A blacktop and gravel road terminates approximately 0.4 km. (0.25 mile) from the area adjacent to a ranch headquarters and about 8 km. (5 miles) west of Winthrop, Washington. Wolf Creek Trail, which starts at the road end, bisects the lower third of the natural area. Directions should be obtained at the Winthrop Ranger Station. Access is excellent during summer and often easy the winter due to limited snow accumu Public accommodations are available throp.

ENVIRONMENT

The Wolf Creek Research Natural located in steep rolling foothills of the Range. It ranges in elevation from 79 m. (2,600 to 3,200 ft.). Topography from gentle and rolling to steep; betw ridgetop at the north boundary an slopes adjacent to Wolf Creek along th boundary are a series of small benche direction is southerly. Most of the pare are granite or granodiorite with som mentary types at lower elevations.

A largely continental climate prevai precipitation occurs as snow during t cloudy winters. Summers are warm, precipitation, and largely cloudless. 3 months of drought are common. C data from Winthrop, located in a valle (5 miles) to the southeast, are as follov Weather Bureau 1965):

Mean annual temperature	7.1°C.
Mean January temperature	-7.5°C.
Mean July temperature	20.1°C.
Mean January minimum temperature	-13.1°C.
Mean July maximum temperature	30.5°C.
Average annual precipitation	368 mm.
June through August precipitation	58 mm.

Soils in the area have not been n Cursory examination suggests they a erally colluvial Regosols (Entisols) wi profile development. Sand to pea-size g gravel is common, some aerially de volcanic ash is present, and the soils ge

Purshia tridentata/Agropyron inerme - Festuca idahoensis	32 ha. (80 acres)
Pinus ponderosa/Purshia tridentata/Festuca idahoensis	16 ha. (40 acres)
Pinus ponderosa - Pseudotsuga menziesii/Symphoricarpos albus/ Agropyron inerme	8 ha. (20 acres)

The *Purshia/Agropyron - Festuca* community type could probably be assigned to Küchler's (1964) Type 55, Sagebrush Steppe. The *Pinus/Purshia/Agropyron* community type is assignable to SAF cover type 237, Interior Ponderosa Pine (Society of American Foresters 1954), and Küchler's Type 10, Ponderosa Shrub Forest. *Pinus - Pseudotsuga/Symphoricarpos/Agropyron* communities could be assigned to SAF forest cover type 214, Ponderosa Pine - Larch - Douglas-Fir, and Küchler's Type 12, Douglas Fir Forest. The area falls within a forested zone but is largely devoid of trees due to soil factors and slope aspect.

The *Purshia tridentata/Agropyron inerme - Festuca idahoensis* stands are characteristically dominated by beardless bluebunch wheatgrass (*Agropyron inerme*) and bitterbrush with some Idaho fescue (*Festuca idahoensis*), *Balsamorhiza sigittata*, Sandberg bluegrass (*Poa sandbergii*), and very scattered ponderosa pine (*Pinus ponderosa*) (fig. WW-2). This community type occurs from reasonably level benches to steep southerly slopes, some of which exceed 100 percent. The type can be related to either the *Purshia/Festuca* or *Purshia/Agropyron* types described by Daubenmire (1970).

The *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* community is a very open type characterized by a 15- to 25- percent crown cover of ponderosa pine and a shift in understory dominance from beardless bluebunch wheatgrass to Idaho fescue (fig. WW-2). This community is characteristic of gentler slopes on upper portions of the tract. Pine growth is slow, even in saplings and poles (fig. WW-2), suggesting limited forest productivity

stands have overstories domin
derosa pine, but tree reproduct
Douglas-fir. Ground vegetation is
by *Symphoricarpos albus* and b
bunch wheatgrass. Numerous p
are fire-scarred at their bases. M
basal areas (20.5 sq. m. per ha. o
acre) and slow diameter growth
gest limited forest growth potent

The area is important wint
mule deer (*Odocoileus hemionus*
they move off the tract sufficientl
spring to prevent grazing dama
Other mammals believed to utili
residents or transients are lis
WW-1.

HISTORY OF DISTURBA

Fire scars on ponderosa p
ground fires periodically burned
to initiation of fire control prog
Lack of dominant old-growth fi
area further suggests all portion
have burned at some time. Su
volume is present on the grassla
fire so one should assume it has

The Wolf Creek Research N
has been used as livestock rang
1900, primarily for cattle. Heav
occurred in the late 1930's and
and caused a change of vegeta
tion. However, in 1948, initiatio
ing season was changed to Jun
time native forage has dried su
it is low in livestock palatabili
damaged by light use. Presen
pass through the area annually
to higher elevation ranges. Ve
cators suggest that an upward t
condition has persisted over the

Some trees were removed from
of the area 5 to 8 years ago, an
recently taken place adjacent
the area on State-owned land

No research is known to be in progress on the Wolf Creek Research Natural Area. The area provides interesting opportunities to study: (1) effects of winter-game use on palatable shrub-bunchgrass vegetation; and (2) biomass productivity in relation to soils and topography in three closely related and intergrading plant communities developed under a single macroclimate.

MAPS AND AERIAL PHOTOGRAPHS

No special topographic or geologic maps are available for the natural area which are sufficiently detailed to be useful. Either the District Ranger (Winthrop Ranger District) or Forest Supervisor (Okanogan National Forest, Okanogan, Washington) can provide details on the most recent aerial photo coverage of the area.

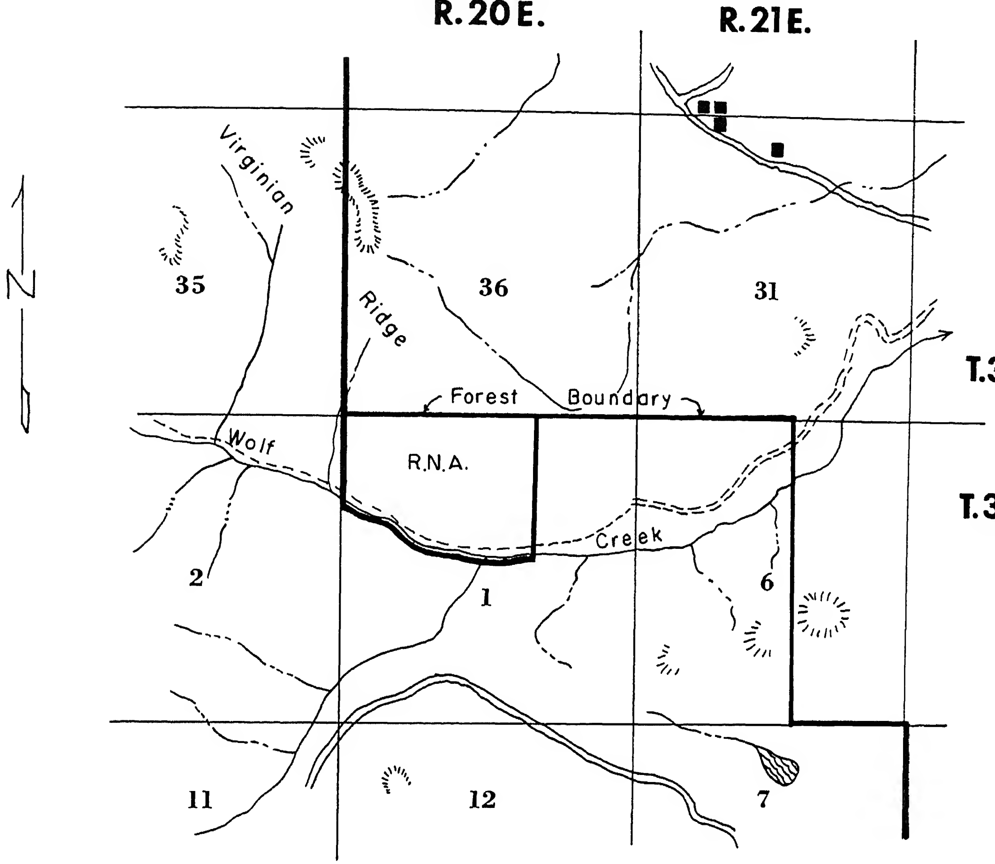
62, 131 p., illus.

Küchler, A. W.
1964. Manual to accompany the m potential natural vegetation conterminous United States Geogr. Soc. Spec. Publ. 36, v paging, illus.

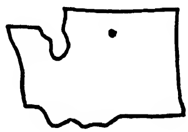
Society of American Foresters
1954. Forest cover types of North A (exclusive of Mexico). 67 p., Washington, D.C.

U.S. Weather Bureau
1965. Climatic summary of the States — supplement for through 1960, Washington. C tography of the United States 92 p., illus.

		dusky shrew
	Sorex palustris	northern water sh
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	red bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myoti
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eare
Lagomorpha	*Lepus americanus*	snowshoe hare
	Lepus californicus	black-tailed jack ra
	Lepus townsendi	white-tailed jack ra
	Ochotona princeps	pika
	Sylvilagus nuttalli	mountain cottontai
Rodentia	*Castor canadensis*	beaver
	Clethrionomys gapperi	Gapper red-backed
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmu
	Eutamias townsendi	Townsend chipmun
	Glaucomys sabrinus	northern flying squ
	Marmota flaviventris	yellow-bellied marm
	Microtus longicaudus	long-tailed vole
	Microtus montanus	mountain vole
	Microtus oregoni	Oregon or creeping
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood r
	Perognathus parvus	Great Basin pocket
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus saturatus	Cascades mantled g
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket gop
	Zapus princeps	western jumping mo
	Zapus trinotatus	Pacific jumping mou
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cou
	Gulo luscus	wolverine
	Lynx canadensis	Canadian lynx
	Lynx rufus	bobcat
	Martes americana	marten
	Mephitis mephitis	striped skunk
	Mustela erminea	short-tailed weasel o
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Taxidea taxus	badger
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus*	



LEGEND



BOUNDARY, WOLF CREEK RESEARCH NATURAL AREA

ROADS

SECTION LINE

STREAMS

TRAIL

BUILDINGS

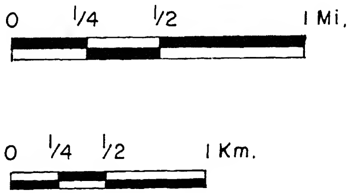


Figure WW-2.—Communities of Wolf Creek Researc
Area. Upper left: Community of bitterbrush a
less bluebunch wheatgrass with occasional p
pine and forbs growing on a bench. Upper rig
munity dominated by beardless bluebunch w
with some bitterbrush and occasional ponde
growing on steep south slope. Lower left: C
derosa pine/bitterbrush/Idaho fescue commun
ing on an upper slope bench. Lower right:
derosa pine-Douglas-fir community growing c
soil and steep slopes probably represents th
zonal forest community.




APPENDIX I
Examples of Federal Agency Regulations Governing Establishment and Use of Research Natural Areas

Section 251.23 of Title 36, Code of Federal Regulations, which provides the authority for establishment of Research Natural Areas and other experimental areas on National Forest lands, reads as follows:

The Chief of the Forest Service shall establish and permanently record a series of areas on National Forest land to be known as experimental forests or experimental ranges, sufficient in number and size to provide adequately for the research necessary to serve as a basis for the management of forest and range land in each forest region. Also, when appropriate, the Chief shall establish a series of research natural areas, sufficient in number and size to illustrate adequately or typify for research or educational purposes, the important forest and range types in each forest region, as well as other plant communities that have special or unique characteristics of scientific interest and importance. Research Natural Areas will be retained in a virgin or unmodified condition except where measures are required to maintain a plant community which the area is intended to represent. Within areas designated by this regulation, occupancy under a special-use permit shall not be allowed, nor the construction of permanent improvements permitted except improvements required in connection with their experimental use, unless authorized by the Chief of the Forest Service.

Section 4063, as of February, 197
follows:

POLICY

The Forest Service will coope
other public agencies and such pr
professional organizations as Th
Conservancy, Society of American
Society for Range Management, an
cal Society of America, to establish a
tain an adequate number and vari
search natural areas. The use of F
vice research natural areas by scienti
and outside the Forest Service, an
certain educational purposes is en

Research natural areas should re
many as possible of the major, natur
types or other plant communities in
fied condition. Other forest or ran
tions that have special or unique c
istics of scientific or educational inte
as outliers of grass or timber type
bog associations, or unusual combi
flora may also be set aside. To whate
is feasible, animal life also should b
in unmodified condition.

As a general guide, these areas sho
evidence of no major disturbance
such as timber cutting, for at least
50 years. On rare occasions, howe
valuable plant community that sh
preserved, the most suitable area
proaches these conditions should be

resource management organization. Supervisors and research project leaders ponsible for proposing establishment, trict rangers for protection. The scien- d educational uses made of natural y Forest Service and other scientists rmally be a research responsibility.

arch natural areas should be large to provide essentially unmodified ons in their interior portions — usually 0 acres. Exceptions to the usual mini- f 300 acres should be limited to truly ding cases. Seldom can tracts smaller 0 acres be expected to maintain essen- nmodified conditions unless they are d by scenic or other areas that are ined in relatively unmodified condi-

ECTION AND AGEMENT

search natural area must be protected activities which directly or indirectly ecological processes if the area is to be for observation and research on plant mal succession, habitat requirements ies, insect and fungus depredations, icrobiology, phenology, and related ena. Logging activities and uncon- grazing by domestic livestock are not ed. The criterion for management of h natural areas is for protection against ral encroachments.

TIFICATION

arch natural areas should be identi- the administrative records as to loca- urpose, and objectives, and the bound- rked in the field. Signs which would attract sightseers, recreationists, and visitors should be avoided. However,

Research natural area boundaries need not be fenced unless necessary for protection against livestock or excessive human use.

PUBLICITY

Publicity is generally limited to professional groups at either national, State, or university levels and mainly to inform scientists and educators of the location, vegetation types, and administering agency in order to make the fullest proper use of the research natural areas. Other publicity should be avoided.

PHYSICAL IMPROVEMENTS

Generally speaking no physical improvements such as roads, trails, fences, or buildings should be permitted within a research natural area. Temporary facilities needed for research, such as instrument shelters, may be installed with the approval of the Station Director. Except as essential to fire protection of adjoining lands, no buildings, roads, or trails should be permitted at or on the boundaries of a research natural area.

PROTECTION

Fires within a research natural area should be extinguished as quickly as possible, but no cleanup, fire hazard reduction, or reforestation should be undertaken.

No control of insects or disease should be instituted unless the infestation or infection threatens adjacent forests or will drastically alter the natural ecological processes within; for example, white pine blister rust. Insect- or disease-killed trees are a part of the natural forest and should not be felled or removed.

PUBLIC USE

Picnicking, camping, collecting plants, gathering nuts and herbs, picking berries, and other public uses which contribute to modifi-

threaten serious impairment ... educational value. Hunting, fishing, and trapping should be prohibited only if the removal of game, fish, and furbearers is likely to be on a scale sufficient to affect the biotic communities.

SCIENTIFIC AND EDUCATIONAL USE

The Forest Service encourages use of research natural areas by responsible scientists and educators. Generally the educational use should be at the upper classman or graduate college level. Research on natural areas will be essentially nondestructive in nature. Studies that require timber felling, seedbed modification, or extensive soil excavation should be done on the experimental forests and ranges, or similar areas.

Because of the fragile character of most research natural areas, cooperative agreements will normally be prepared between the Forest Service and non-Forest Service scientists outlining briefly the mechanics of field research and the limitations thereto. Forest Service scientists should cooperate in the research whenever possible in order to derive the greater benefit from the work.

Station Directors may authorize such management practices as are necessary to preserve some representation of the vegetation for which the natural area was created originally, including *Ribes* eradication in white pine types, control of excessive animal populations, or prescribed burning or grazing to maintain a grass community. Only tried and reliable techniques will be used, and then only where the vegetative type would otherwise be lost without management. The criterion here is that the management must provide a closer approximation of the vegetation and the processes governing the vegetation than would be possible without management. If doubt exists about the need for vegetation management or the reliability of the techniques, then nothing should be done. Where management practices are necessary a portion of natural areas should be kept untreated as a "green check."

MINERAL ENTRY

Research natural areas should be withdrawn from mineral entry.

APPENDIX II
Index to Research Natural Areas By Forest Cover and Vegetation Types

earch Natural Areas described in this guidebook are indexed here according to the cover and vegetation types described by the Society of American Foresters (1954) and er (1964), respectively. The areas are coded here according to the listing provided in and on the back cover of this report.

No.	Type name	Area in which type exists
205	Mountain Hemlock - Subalpine Fir *Tsuga mertensiana - Abies lasiocarpa*	BU, GL, OR, WM
206	Engelmann Spruce - Subalpine Fir *Picea engelmannii - Abies lasiocarpa*	GL
207	Red Fir *Abies magnifica*	AC, BP
208	Whitebark Pine *Pinus albicaulis*	
210	Interior Douglas-Fir *Pseudotsuga menziesii*	PE
211	White Fir *Abies concolor*	AC, BP
212	Larch - Douglas-Fir *Larix occidentalis - Pseudotsuga menziesii*	BB
213	Grand Fir - Larch - Douglas-Fir *Abies grandis - Larix occidentalis -* *Pseudotsuga menziesii*	OD, PE
214	Ponderosa Pine - Larch - Douglas-Fir *Pinus ponderosa - Larix occidentalis -* *Pseudotsuga menziesii*	BB, ME, MI, ML, PE, RC, WW
215	Western White Pine *Pinus monticola*	RC
217	Aspen *Populus tremuloides*	PN, TP
218	Lodgepole Pine	[illegible]

SAF-222	Black Cottonwood - Willow *Populus trichocarpa - Salix* spp.	PO
SAF-223	Sitka Spruce *Picea sitchensis*	NC, TW
AF-224	Western Hemlock *Tsuga heterophylla*	DP, HA, HI, LC, NC, NF, QU, WR
AF-225	Sitka Spruce - Western Hemlock *Picea sitchensis - Tsuga heterophylla*	DP, HI, LC, NC, QU
AF-226	Pacific Silver Fir - Hemlock *Abies amabilis - Tsuga* spp.	BR, BU, HA, LA, NF, SR, WM
AF-227	Western Redcedar - Western Hemlock *Thuja plicata - Tsuga heterophylla*	LA, LC, NF, QU
AF-228	Western Redcedar *Thuja plicata*	CF
AF-229	Pacific Douglas-Fir *Pseudotsuga menziesii*	BA, CF, JC, WH, WR
AF-230	Douglas-Fir - Western Hemlock *Pseudotsuga menziesii - Tsuga heterophylla*	BA, CF, CH, LC, NF, QU, TW, WM, WR
AF-231	Port-Orford Cedar - Douglas-Fir *Chamaecyparis lawsoniana - Pseudotsuga menziesii*	BP, CO, PO
AF-232	Redwood *Sequoia sempervirens*	WH
AF-233	Oregon White Oak *Quercus garryana*	MA, ML, PI
AF-234	Oak - Madrone *Quercus - Arbutus menziesii*	AS, PO
F-237	Interior Ponderosa Pine *Pinus ponderosa*	BJ, CC, GM, LO, ME, MI, OD, PN, PR, TP, WW
F-238	Western Juniper *Juniperus occidentalis*	GM, HR, LO, OD
F-243	Ponderosa Pine - Sugar Pine - Fir *Pinus ponderosa - P. lambertiana - Abies* spp.	AC, AS, BP, PR
F-244	Pacific Ponderosa Pine - Douglas-Fir *Pinus ponderosa - Pseudotsuga menziesii*	AS
F-245	Pacific Ponderosa Pine	AS

, QC, TW

BA, CF, CH, CO, LA, LC, NF
WH, WR

BE, BP, HA, LA, LC, NF, OR
WM

BE, BP, GL, LA, NF, OR, SP
WM

AS, BP, PR

WH

BL, GM, LO, MI, PR,

ME, OD, PN, RC, TP

BE, ME, MI, ML, PE

OR, PB, PE, RC

BR, LO, OD

DP, LA, LC, MA, WP

MA, ML, PI

MY

AS

	Arctostaphylos - Castanopsis - Ceanothus	
38	Great Basin Sagebrush *Artemisia*	LO, RH
40	Saltbush - Greasewood *Atriplex - Sarcobatus*	RH
49	Tule Marshes *Scirpus - Typha*	PN, TP
50	Fescue - Wheatgrass *Festuca - Agropyron*	TP
51	Wheatgrass - Bluegrass *Agropyron - Poa*	PB, RC, RH, TP
52	Alpine Meadows and Barren *Agrostis, Carex, Festuca, Poa*	BU, LA, NF, OR
55	Sagebrush Steppe *Artemisia - Agropyron*	ME, RH, WW

ERATURE CITED

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64. Manual to accompany the map of potential natural vegetation of the conterminous United States. Am. Geogr. Soc. Spec. Publ. 36, various paging, illus.

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54. Forest cover types of North America (exclusive of Mexico). 67 p., illus. Washington, D.C.

APPENDIX III
Index to Research Natural Areas by Tree And Important Range Plant Species

earch Natural Areas described in this guidebook are indexed here according to species and selected important range plants present there. The areas are coded here according listings provided in table 1 and on the back cover of this report. Plants are arranged etically by scientific name. A species, when present in small quantities, may be indexed Research Natural Area but not appear in the text writeup; indexing is based on field or other documentation in such cases.

	Area in which type exists
amabilis silver fir	BA, BR, BU, CF, GL, HA, HI, LA, LC, NF, OR, QU, SR, WM, WR
concolor fir	AC, AS, BP, GM, OR, PR
grandis fir	CC, CO, MA, ME, MI, ML, OD, OR, PB, PE, PI, PO, RC
lasiocarpa pine fir	AC, BU, GL, OR, WM
magnifica var. *shastensis* red fir	AC, BP, GL
procera fir	BR, BU, OR, SR, WM, WR
ircinatum naple	AC, AS, BA, BR, BU, CF, CH, CO, HA, HI, JC, LA, LC, MY, NF, OR, PE, PO, QU, TW, WM, WR
labrum as maple	BB, BP
nacrophyllum f maple	AC, AS, CF, CH, HI, JC, LA, LC, MA, MY, PI, PO, TW, WP
yron spicatum unch wheatgrass	BB, CC, HR, LO, ME, ML, PB, RC, RH, TP
yron inerme less bluebunch wheatgrass	WW
rhombifolia	AS, MY

alder	
us menziesii c madrone	AC, AS, CO, MA, PO
staphylos patula[1] manzanita	AC, BP, GM, MI, PR
staphylos viscida -leaved manzanita	AS
nisia arbuscula agebrush	GM
nisia rigida agebrush	ME, RH
nisia tridentata gebrush	GM, HR, LO, RH
us tectorum grass brome	CC, ML, PB, PN, RH, TP
agrostis rubescens rass	BB, CC, ME, OD, PB, PE, PN, TP
geyeri edge	BB, CC, ME, ML, OD, PB, TP
rossii sedge	BJ, GM, MI, PR
nopsis chrysophylla n chinkapin	AC, AS, BP, CH, CO, PO, WH
thus velutinus brush ceanothus	AC, AS, BP, CC, MI, PE, PR, WM
carpus betuloides eaf mountainmahogany	AS
carpus ledifolius af mountainmahogany	CC, GM
aecyparis lawsoniana Orford - cedar	BP, CO, PO
aecyparis nootkatensis a-cedar	BC, LA, NF, OR, WM
s nuttallii c dogwood	AC, BA, CF, PI, PO

pinosa psage	RH
us occidentalis juniper	CC, GM, HR, LO, OD
cristata unegrass	CC, HR, PN, TP
cidentalis larch	BB, ME, MI, ML, OD, PE, RC
rus decurrens - cedar	AC, AS, BP, MI, MY, PE
rpus densiflorus	CO, PO, WH
gelmannii ann spruce	GL
tchensis ruce	DP, HI, JC, LA, LC, NC, QU, TW
lbicaulis rk pine	BU
ttenuata ne pine	BP, WH
ontorta le pine	BB, BJ, GL, PR, SR
mbertiana ine	AC, AS, BP, CO, PO, PR
onticola white pine	AC, BA, BP, CF, GL, OR, PO, RC, WM, WR
onderosa sa pine	AC, AS, BB, BJ, CC, GM, LO, ME, MI, ML, OD, PB, PE, PN, PR, RC, TP, WW
dbergii g bluegrass	CC, GM, ME, ML, PB, PN, RH, TP, WW
unda	(see *Poa sandbergii*)
s tremuloides g aspen	PN, TP
s trichocarpa ottonwood	CF, LC, NF

Purshia tridentata Bitterbrush	BJ, GM, HR, LO, MI, ML, PR, WW
Quercus chrysolepis Canyon live oak	BP, PO
Quercus garryana Oregon white oak	AC, AS, MA, ML, MY, PI, WP
Quercus kelloggii California black oak	AS
Quercus sadleriana Sadler oak	
Quercus vaccinifolia Huckleberry oak	BP
Sequoia sempervirens Coast redwood	WH
Sitanion hystrix Bottlebrush squirrel tail	BJ, HR, LO, ME, MI, PR
Stipa occidentalis Western needlegrass	BJ, MI, ML, PN, PR
Taxus brevifolia Pacific yew	AC, AS, BA, BP, CF, CO, LC, MA, NF, PO, RC, WM, WR
Thuja plicata Western redcedar	BA, CF, HA, HI, JC, LA, LC, MY, NF, PO, QU, WR
Tsuga heterophylla Western hemlock	AC, BA, BR, BU, CF, CO, DP, HA, HI, JC, LA, LC, NC, NF, OR, PO, QU, SR, TW, WH, WM, WR
Tsuga mertensiana Mountain hemlock	AC, BR, BU, GL, LA, NF, OR, SR, WM
Umbellularia californica California laurel	MY, PO, WH

APPENDIX IV
Index to Research Natural Areas by Species of Mammals

arch Natural Areas described in this guidebook are indexed here according to the of mammals which are believed to utilize the tracts either as residents or transients.[1] e of the general absence of field collections and observations, assignments of mammals earch Natural Areas should be considered tentative. The areas are coded here according istings provided in table 1 and on the back cover of this report. Mammals are grouped er and arranged alphabetically by scientific name within the orders.

and species	Area in which type exists
pialia:	
his marsupialis ım	MA, NC, PI, WP
vora:	
orex hoyi shrew	BB
trichus gibbsi mole	AC, AS, BP, BR, BU, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, MA, ME, ML, MY, NC, NF, OR, PE, PI, PO, QU, SR, TW, WH, WM, WP, WR
ıus latimanus -footed mole	AS, BJ, BP, GM
ıus orarius mole	BR, BU, CC, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PO, QU, RC, SR, TW, WH, WM, WR
ıus townsendi end mole	AC, BP, BR, BU, DP, HA, JC, LA, LC, MA, MY, NC, NF, PE, PI, QU, TW, WM, WP
bendirii shrew	AC, BP, BR, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, ML, NC, NF, OR, PE, PO, QU, TW, WH, WM
cinereus d shrew	BB, BU, LA, LC, ME, NF, WW
merriami am shrew	GM, HR, PB
obscurus shrew	BB, BU, CF, DP, HA, HI, JC, LA, LC, ME, ML, NF, OD, PE, QU, SR, TW, WR, WW

and Lost Forest Research Natural Areas are not included in the appendix because of insufficient

rex palustris rthern water shrew	OR, PB, PE, PR, RC, WN, WW
rex preblei eble shrew	CC, OD, PB, RC
rex trigonirostris hland shrew	
rex trowbridgii owbridge shrew	AC, AS, BP, BR, BU, CF, CH, CO, GL, HA, HI, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OR, PE, PI, PO, QU, SR, TW, WH, WM, WR
rex vagrans andering shrew	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
rex yaquinae aquina shrew	NC
hiroptera:	
ntrozous pallidus allid bat	AC, AS, BJ, BP, CC, CH, CO, GL, GM, HR, MA, ME, MY, NC, OD, PB, PI, PO, WH, WP, WW
ptesicus fuscus ig brown bat	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
asionycteris noctivagans ilver-haired bat	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
Lasiurus borealis Red bat	AC, AS, BJ, BP, BR, CH, CO, GL, GM, HA, HR, MA, ME, MI, MY, NC, OR, PE, PI, PO, PR, WH, WM, WP, WW
Lasiurus cinereus Hoary bat	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
Myotis californicus California myotis	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO,

eeni otis	LC, NF
ucifugus own myotis	AC, AS, BB, BJ, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
ubulatus oted myotis	CC, HR, OD, PB, PN, RC, TP
hysanodes myotis	AC, AS, BJ, BP, BR, CC, CH, CO, GL, GM, HR, MA, ME, MI, MY, NC, OD, OR, PB, PE, PI, PO, PR, RC, WH, WM, WP, WW
olans ged myotis	AC, AS, BJ, BP, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, MY, NC, NF, OD, OR, PB, PE, PI, PO, PR, QU, RC, RH, SR, TW, WH, WM, WP, WR, WW
umanensis yotis	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
llus hesperus pipistrel	CC, HR, OD, PB, PN, TP
townsendi d big-eared bat	AC, AS, BJ, BP, BR, CC, CF, CH, CO, DP, GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
a brasiliensis n free-tailed bat	AS, WH
rpha:	
mericanus oe hare	AC, AS, BB, BP, BR, BU, CC, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, ME, MI, ML, NC, NF, OD, OR, PB, PE, PO, QU, RC, SR, TW, WM, WR, WW
alifornicus iled jack rabbit	AS, BJ, GM, HR, ME, PB, PN, PR, RH, TP, WW
ownsendi ailed jack rabbit	ME, WW
a princeps	AC, BR, BU, LA, ME, MI, NF, OR, PE, WM, WW

lvilagus floridanus stern cottontail	
lvilagus idahoensis gmy rabbit	HR
lvilagus nuttalli ountain cottontail	BB, BJ, GM, HR, ME, PB, PN, PR, RC, TP, WW
odentia:	
plodontia rufa ountain beaver	AC, AS, BP, BR, BU, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, ML, MY, NC, NF, OR, PE, PO, QU, SR, TW, WH, WM, WR
rborimus albipes hite-footed vole	BR, CH, CO, NC, PO, WH, WM
rborimus longicaudus ed tree vole	AC, BP, BR, CH, CO, GL, MA, NC, OR, PE, PO, WH, WM
astor canadensis eaver	BU, CC, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, MY, NF, OD, PE, PO, PR, QU, RC, TW, WR, WW
lethrionomys californicus alifornia red-backed vole	AC, BP, BR, CH, CO, GL, MI, ML, MY, NC, OR, PE, PO, WH, WM
lethrionomys gapperi apper red-backed vole	BB, BU, CC, CF, DP, HA, HI, JC, LA, LC, ME, NF, OD, PB, QU, RC, SR, TW, WR, WW
ipodomys heermanni eermann kangaroo rat	
ipodomys ordi rd kangaroo rat	HR
rethizon dorsatum orcupine	AC, AS, BB, BJ, BP, BR, BU, CC, CF, CH, CO, GL, GM, HR, ME, MI, ML, NC, NF, OD, OR, PB, PE, PN, PO, PR, RC, SR, TP, WH, WM, WR, WW
Eutamias amoenus Yellow-pine chipmunk	AC, AS, BB, BJ, BP, BR, BU, CC, GL, GM, HI, LA, ME, MI, ML, NF, OD, OR, PB, PE, PN, PR, RC, SR, TP, WM, WW
Eutamias minimus Least chipmunk	HR, RH
Eutamias ruficaudus Red-tailed chipmunk	BB
Eutamias townsendi T	AC, AS, BP, BR, BU, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF,

s curtatus le	GM, HR, RH
a caligata narmot	BU, NF
ta flaviventris bellied marmot	BB, CC, HR, ML, OD, PN, TP, WW
s californicus nia vole	AS
us canicaudus iled vole	MA, PI, WP
us longicaudus iled vole	AC, BB, BR, BU, CC, CF, CH, DP, GL, HA, HI, HR, JC, LA, LC, ME, MI, ML, NC, NF, OD, OR, PB, PE, PN, PO, PR, QU, RC, SR, TP, TW, WH, WM, WR, WW
us montanus in vole	CC, GM, HR, ME, OD, PB, PN, PR, RC, TP, WW
us oregoni or creeping vole	AC, BP, BR, BU, CF, CH, CO, DP, GL, HA, HI, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OR, PE, PI, PO, QU, SR, TW, WH, WM, WR, WW
us pennsylvanicus v vole	BB, PN, TP
us richardsoni dson vole	AC, BR, BU, CC, GL, LA, LC, NF, OD, OR, PB, RC, WM, WW
us townsendi nd vole	AC, BP, BR, CH, DP, GL, HA, JC, LC, MA, MY, OR, PE, PI, PO, QU, TW, WH, WM, WP
tor coypus	WP
a cinerea ailed wood rat	AC, BB, BJ, BP, BR, BU, CC, CF, CH, DP, GL, GM, HA, HI, HR, JC, LA, LC, ME, MI, ML, NC, NF, OD, OR, PB, PE, PN, PO, PR, QU, RC, SR, TP, TW, WM, WR, WW
a fuscipes ooted wood rat	AS, CH, GM, MA, MY, PI, PO, WH, WP
a zibethicus t	DP, MY, NF, TP, WP
nys leucogaster	HR, PN, RH, TP

Deer mouse	GL, GM, HA, HI, HR, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PB, PE, PI, PN, PO, PR, QU, RC, RH, SR, TP, TW, WH, WM, WP, WR, WW
Phenacomys intermedius Heather vole	AC, BR, BU, CC, GL, HI, LA, MI, NF, OD, OR, PB, PE, RC, SR, WM, WW
Reithrodontomys megalotis Western harvest mouse	HR, PN, RH, TP
Sciurus griseus Western gray squirrel	AS, BJ, GM, MA, ME, MI, ML, MY, PE, PI, PR, W
Spermophilus beecheyi California ground squirrel	AS, CH, HR, MA, PI, PO, WH, WP
Spermophilus beldingi Belding ground squirrel	BJ, CC, HR, OD
Spermophilus columbianus Columbian ground squirrel	BB, CC, PB, PN, RC, TP
Spermophilus lateralis Mantled ground squirrel	AC, AS, BB, BJ, BP, CC, GL, GM, MI, ML, OD, PB, PE, PR, RC
Spermophilus saturatus Cascades mantled ground squirrel	BU, LA, ME, SR, WW
Spermophilus townsendi Townsend ground squirrel	HR, ME, RH
Spermophilus washingtoni Washington ground squirrel	
Synaptomys borealis Northern bog vole	NF
Tamiasciurus douglasi Chickaree	AC, AS, BJ, BP, BR, BU, CF, CH, CO, DP, GL, GM, HA, HI, JC, LA, LC, MA, ME, MI, ML, MY, NC, NF, OD, OR, PE, PI, PO, PR, QU, SR, TW, WH, WM, WR, WW
Tamiasciurus hudsonicus Red squirrel	BB, CC, PB, PN, RC, TP
Thomomys bottae Valley pocket gopher	AS
Thomomys bulbivorus Giant pocket gopher	MA, PI, WP